

US EPA RECORDS CENTER REGION 5



494213

**Initial
Site Investigation
Former Coal Gas Manufacturing Plant
Station "B"
Detroit, Michigan**

prepared for

michcon

Michigan Consolidated Gas Company

April, 1985

20356

EDI ENGINEERING & SCIENCE
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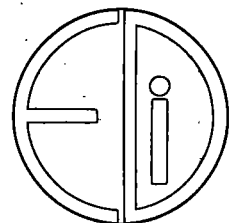


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Re: RCRA Regulatory Interpretation of Coal Gasification
Plant Wastes

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EXECUTIVE SUMMARY

An extensive investigation and analysis was conducted of the air, surface and subsurface soils, and groundwater at the former Michigan Consolidated Gas Manufacturing Plant, Station B, located in Detroit, Michigan.

Ambient air sampling on the site revealed ambient levels to be nondetectable for benzene, toluene and xylene at all surface locations. Subsurface air sampling in a former gas holder location detected the presence of benzene, toluene and xylene. However, the levels are over 100 times below Occupational Safety and Health Administration (OSHA) 8-hour Threshold Limit Value (TLV).

Analysis of surface soil samples in the northern portion of the site indicate the absence of chemicals associated with the coal gas production process above background area soils and soils from the urban Detroit area.

Analysis of subsurface soils in the southern half of the site adjacent to the Detroit River reveal elevated levels of total cyanide at 52 mg/kg. The cyanide in the soil is thought to be primarily in the less toxic ferric ferrocyanide form. No surface soil samples contained cyanide, except in two asphalt samples taken on-site. Previous evaluation of Dr. Jay Goodman, a certified toxicologist, for other Mich Con sites indicates these levels of cyanide in subsurface soils do not pose a significant health hazard.

Elevated levels of chemicals of concern in subsurface soils were found at depths greater than 5.0 feet below the ground surface in the northern portion of the site. Contamination at this depth is isolated from human contact with normal site usage. Additionally, the surface asphalt concrete covering most of this area further isolates the contaminants and restricts their contact with infiltrating surface waters.

Site development of the southern portion of the station may require special handling of the soils and groundwater. Detailed subsurface investigation in areas of potential excavation are required to further define and characterize subsurface materials. Construction requirements may include provisions for handling excavated materials in accordance with Resource Conservation and

Recovery Act (RCRA) and Michigan Department of Natural Resources (MDNR) laws and regulations. Final site alteration may include provision for isolation of remaining waste material through capping with clean soils and/or asphalt concrete.

Groundwater beneath the site, while containing levels of contamination, is not part of an aquifer system and, therefore, isolated from human consumption. There are indications that the groundwater is in communication with the Detroit River.

The groundwater from under the site is hydraulically connected to the Detroit River which is located adjacent to the site. The hydrogeological data suggests that the groundwater flow to the river is relatively slow and in low to moderate volumes due to the low permeability of the subsurface soils and the relatively moderate recharge volumes of water. Groundwater released from the site into the river is estimated at 5,000 gallons per day.

Using a worst case contaminant concentration scenario and applying it to a surface water discharge and dilution formula, the resultant data suggests that this scenario would not produce a groundwater release of any of the contaminants of concern to surface waters that would exceed analytical detection limits at the outer edge of the hypothetical mixing zone. Dilution calculations for mercury concentrations found in the groundwater samples W-3, W-4, W-5 and W-6 are not appropriate because of the MDNR established policy of requiring zero discharge of mercury in the surface waters of Michigan. It was calculated that only an estimated 0.06397 lbs of mercury per year would be released to the Detroit River using the worst case assumptions. The yearly loading from the contaminated groundwater under the site would not appear to represent a significant burden upon the aquatic ecosystem of the Detroit River.

BACKGROUND

COAL GAS MANUFACTURING PROCESS

From the mid 1800's until the 1950's, manufactured gas plants were widely used for producing gas for lighting and heating from coal. When interstate pipelines were introduced for natural gas transmission in the 1930's, manufactured gas plants rapidly disappeared because they could not compete with the less expensive natural gas. Some plants continued standby operations until the mid 1950's.

The site for a coal gasification plant, sometimes called a gas works, required considerable area both for the plant and for any future expansion. As readily available transportation was a necessity for delivering coal and removing residual products, gas works were usually located adjacent to railways and navigable waters.

Gas plants manufactured three basic types of gas: 1) coal or coke oven gas; 2) oil gas; and 3) carburetted water gas. A coal gas plant consisted of large brick ovens (retorts) partially filled with coal. When these ovens were heated, the coal in the ovens was partially vaporized resulting in manufactured gas. A portion of the unvaporized coal remains as coke, some of which could be burned to heat the ovens during the next cycle.

During the manufacture of carburetted water gas, air is blown across a bed of burning coal or coke to a brick-filled vessel. When the bricks reach the appropriate temperature, the air is replaced with steam and oil is sprayed and vaporized on the hot bricks. The product is called carburetted water or blue gas.

The oil gas plant operates similarly and produces gas with the highest heat content. In this case, brick is first heated by burning oil. After reaching the proper temperature, the flame is extinguished and additional oil is sprayed on the bricks. The oil vaporizes and results in oil gas.

The most common method of manufacturing gas, particularly in the smaller communities, was coal or coke oven gas. As explained previously, a coal gas plant consisted of large brick ovens called retorts which were partially filled with

coal. As the ovens were heated, the coal was vaporized, resulting in manufactured gas.

On top of the retort, the manufactured gas passed through the hydraulic main where the temperature of the coal gas produced in the retort is initially lowered. Vapors of liquids with the highest boiling points, such as the heavy tars, condensed here and were then removed.

After the gas left the hydraulic main, it was further cooled from 130°F-150°F to approximately air temperature by pulling it through air or water condensers. Sometimes scrubbers removed the impurity naphthalene from the gas before it entered the condenser, since the white flaky substance often clogged pipes. Vapors of liquids with lower boiling points, such as ammonia and light oils, were removed through the condensation and separation methods.

The exhauster, a rotary gas pump, drew the gas from the retort, through the hydraulic main and condenser, and then forced the gas through purifying vessels and to the gas holders.

Gaseous impurities were removed from the gas before distribution for various heating applications. Sulfur compounds, carbon dioxide, hydrogen cyanide and ammonia were removed by forcing the gas through washers, scrubbers, and "dry purifiers". Dry purifiers consisted of a series of trays and sieves containing lime or hydrated iron oxide mixed with wood chips.

Ultimately, the purified gas was stored in a gas holder. Gas holders were built with either an underground foundation with a banking left in the center as a support for the roof or a foundation at grade level. Most tanks were telescoping to provide greater capacity. A small gas holder, called the governor, regulated flow into the gas holder and distribution to the public.

GENERAL SETTING

Station B is located in Section 10 of Township 2 South, Range 12 East (T2S, R12E) of Wayne County. The site lies along the Detroit River at the intersection of Jefferson Avenue and Meldrum Street just west of the MacArthur Bridge. The site occupies approximately 12.0 acres and is bounded by the Detroit River

on the south and Jefferson Avenue on the north. The location is illustrated in Figure 1.

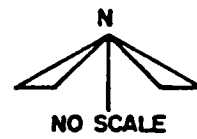
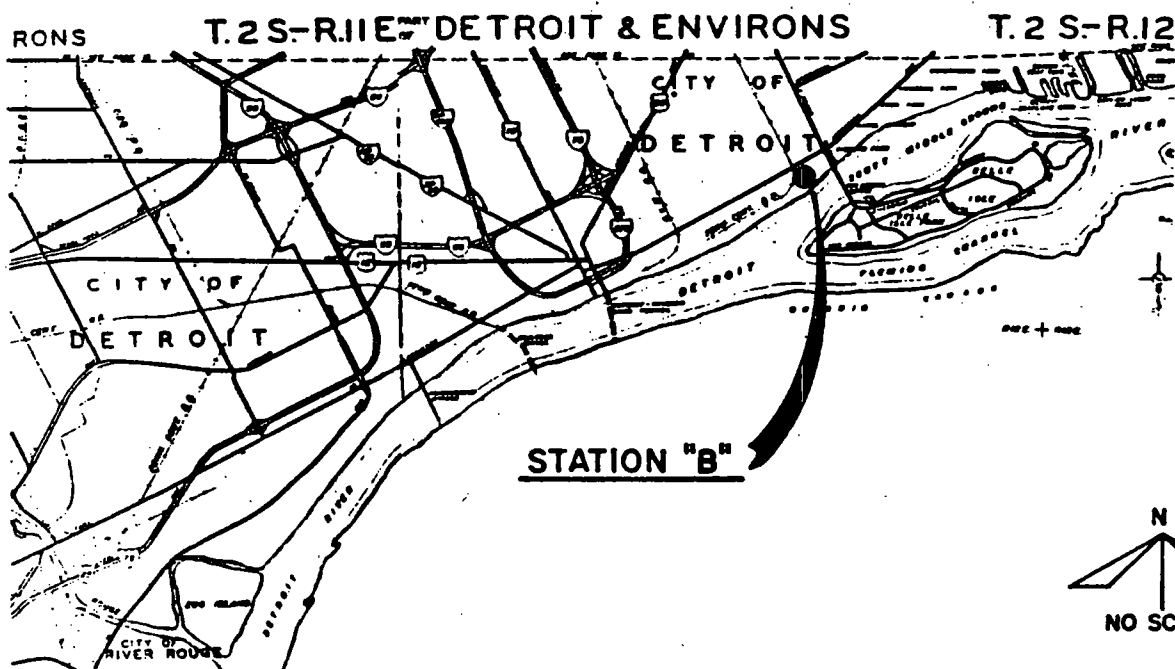
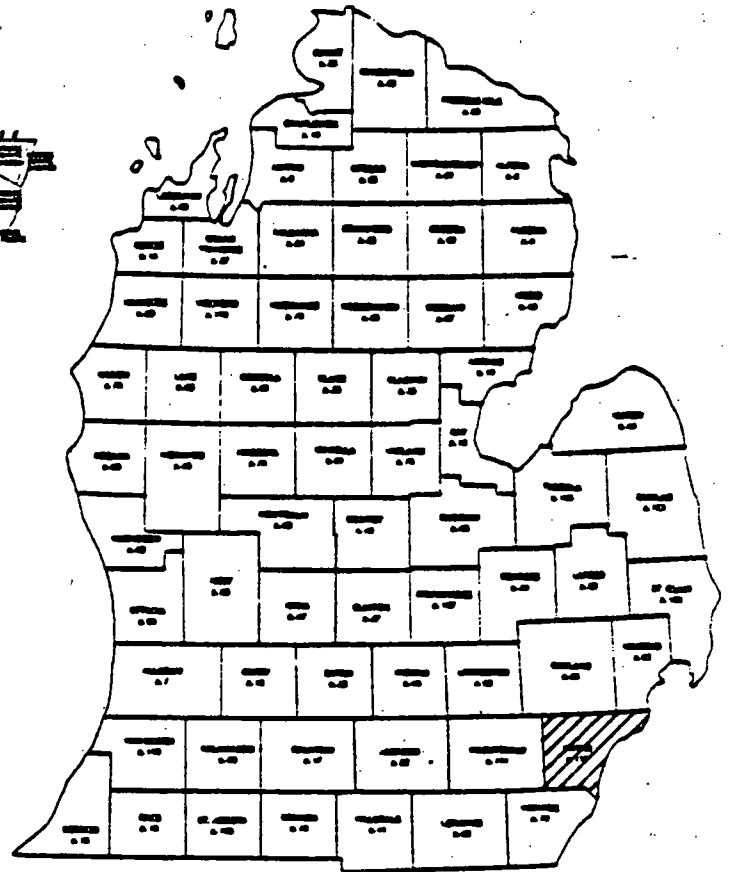
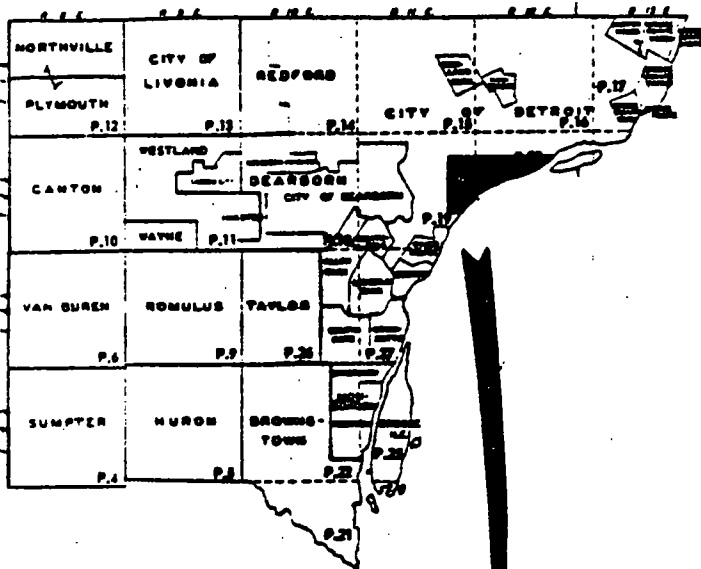
SITE HISTORY

Mutual Gas and Light Company, Detroit City Gas Company, and finally Michigan Consolidated Gas Company operated the gas producing facility from 1871 to 1954. All three methods of gas production (retort coal gas, carburetted water gas, and oil gas) were employed at different stages of operation of the plant. Figure 2 shows the relative location of the various processing facilities based upon mapping of the site in 1935. Information indicates two separate gas production processes existed at that time: 1) coal gas manufacturing plant and 2) water gas manufacturing plant, both located in the approximate center of the site. Gas holder storage prior to distribution was located in the northern portion of the site adjacent to Jefferson Avenue (see Figure 2).

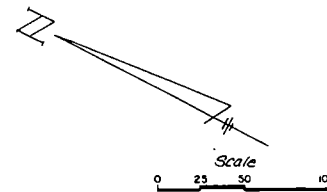
After 1954, the gasification plant was dismantled when natural gas pipeline distribution became widely established.

The existing site is divided into two areas based upon current site usage. The portion of the site between East Jefferson Avenue and Wight Street extended is divided diagonally by railway trackage (see Figure 2). With the exception of the railroad right-of-way, the surface of this site is almost entirely covered with asphalt concrete. Present structures on this site include the buildings directly east of the tracks which were part of the former coal gas manufacturing plant. This portion of the site is currently used by the City of Detroit Parks and Recreation Department for storage purposes.

The southern portion of the site extending from approximate Sta. 7+50E to the Detroit River, comprising approximately seven acres, is under consideration for future development by the City of Detroit. Fencing currently surrounds this area and access is controlled by security personnel.



MICHIGAN CONSOLIDATED GAS CO.
FIGURE 1
GENERAL LOCATION MAP
OCT. 1984 20288

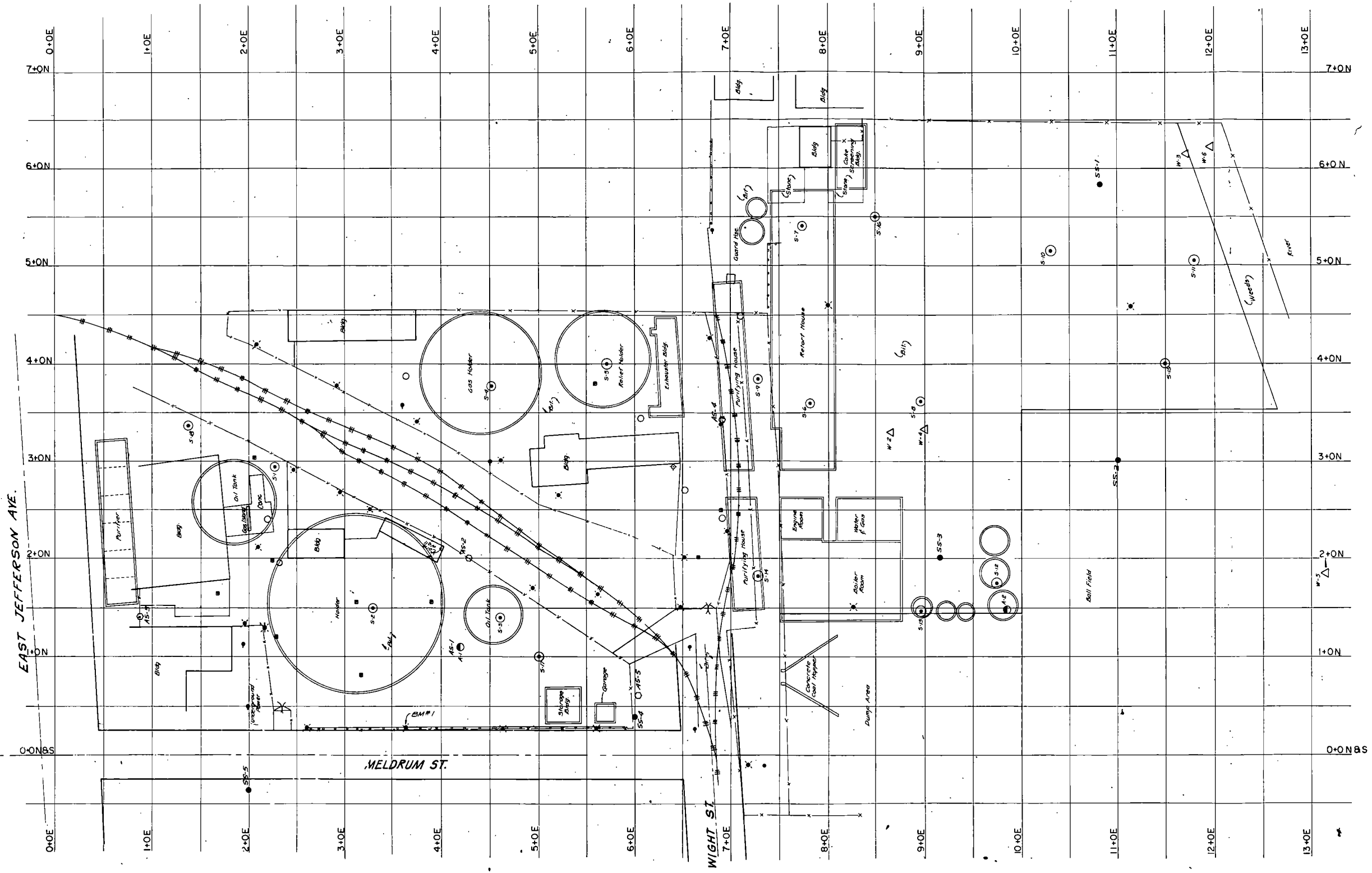


LIST OF LOCATIONS

SOIL BORE	LOCATION	DATE COMPLETED	AIR WELLS	LOCATION	DATE COMPLETED
S-1	2 - 550 2 - 27C	7/25/84	A-1	1 - 10N 4 - 20E	7/19/84
S-2	1 - 50N 3 - 10E	7/18/84	A-2	1 - 40N 9 - 85E	7/24/84
S-3	1 - 40N 2 - 40E	7/18/84	WATER WELLS	LOCATION	DATE COMPLETED
S-4	3 - 20N 3 - 52E	7/19/84	W-1	Dry Well	---
S-5	4 - 00N 5 - 71E	7/19/84	W-2	3 - 30N 8 - 65E	7/24/84
S-6	3 - 60N 2 - 82E	7/20/84	A-3	8 - 15N 11 - 78E	7/23/84
S-7	5 - 10N 2 - 75E	7/20/84	W-3	3 - 30N 9 - 00E	12/18/84
S-8	3 - 62N 9 - 96E	7/23/84	W-4	2 - 00N 13 - 14E	12/13/84
S-9	3 - 85N 2 - 28E	7/23/84	W-5	6 - 22N 11 - 97E	12/3/84
S-10	5 - 150N 10 - 100E	7/23/84	SURFACE SAMPLES	LOCATION	DATE COMPLETED
S-11	5 - 05N 11 - 80E	7/23/84	SS-1	5 - 20N 10 - 93E	7/05/84
S-12	1 - 75N 9 - 75E	7/24/84	SS-2	3 - 00N 11 - 00E	7/05/84
S-13	1 - 40N 9 - 97E	7/24/84	SS-3	2 - 00N 9 - 13E	7/05/84
S-14	1 - 82N 7 - 28E	7/24/84	SS-4	0 - 30N 6 - 00E	7/05/84
S-15	4 - 00N 11 - 50E	9/13/84	SS-5	0 - 35N 2 - 00E	7/05/84
S-16	5 - 60N 8 - 100E	9/13/84			
S-17	1 - 00N 5 - 90E	9/13/84			
S-18	1 - 30N 1 - 38E	9/13/84			
AIR SAMPLES	LOCATION	DATE COMPLETED			
AS-1	1 - 10N 1 - 20E	10/4/84			
AS-2	2 - 00N 1 - 29E	10/4/84			
AS-3	1 - 30N 0 - 80E	10/4/84			
AS-4	1 - 10N 8 - 62E	10/4/84			
AS-5	0 - 60N 6 - 04E	10/4/84			

LEGEND

- Surface Sample (SS Series)
- Air Sample (AS Series)
- ⊙ Air Well (A Series)
- △ Water Well (W Series)
- ⊕ Soil Boring (S Series)
- ▭ Former Coal Gas Manufacturing Plant Structure.
- ▭ Existing Structure.
- x- Fence
- Railroad
- ⋄ Light Pole
- Guard Rail
- ⊞ Catch Basin
- Power Pole
- Guy Pole



Note
B.M. #1 - B.S. Nail in N Side Light Pole
3+63E, 0+27N Elev 117.04

SAMPLE LOCATIONS

FIGURE 2

EDJ ENGINEERING & SCIENCE <small>ENGINEERS • GEOLOGISTS • BIOLOGISTS • CHEMISTS</small> <small>1171 CASCADIA RD. ANN ARBOR, MI 48106-1500 (313) 963-8875</small>					
MICHIGAN CONSOLIDATED GAS COMPANY				STATION B DETROIT, MICHIGAN	
REVISIONS DR. BY S.A.M. DATE 8/84 CHD. BY DATE 8/84 REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS BY DATE				DATE 8/84 PROJECT NO. 20288 SHEET NO.	

EAST JEFFERSON AVE.

MELDRUM ST.

WIGHT ST.

LIST OF LOCATIONS

SOIL BORINGS	LOCATION	DATE COMPLETED	AIR WELLS	LOCATION	DATE COMPLETED
S-1	2 + 95N	7/19/84	A-1	1 + 10N	7/19/84
S-2	1 + 50N	7/18/84	A-2	1 + 49N	7/24/84
S-3	1 + 40N	7/18/84			
S-4	4 + 78N	7/19/84			
S-5	4 + 00N	7/19/84			
S-6	3 + 60N	7/20/84			
S-7	5 + 40N	7/20/84			
S-8	3 + 52N	7/23/84			
S-9	3 + 85N	7/24/84			
S-10	5 + 15N	7/23/84			
S-11	5 + 00N	7/24/83			
S-12	1 + 75N	7/24/84			
S-13	1 + 46N	7/24/84			
S-14	1 + 82N	7/24/84			
S-15	4 + 00N	9/13/84			
S-16	5 + 60N	9/13/84			
S-17	5 + 00E	9/13/84			
S-18	1 + 30E	9/13/84			

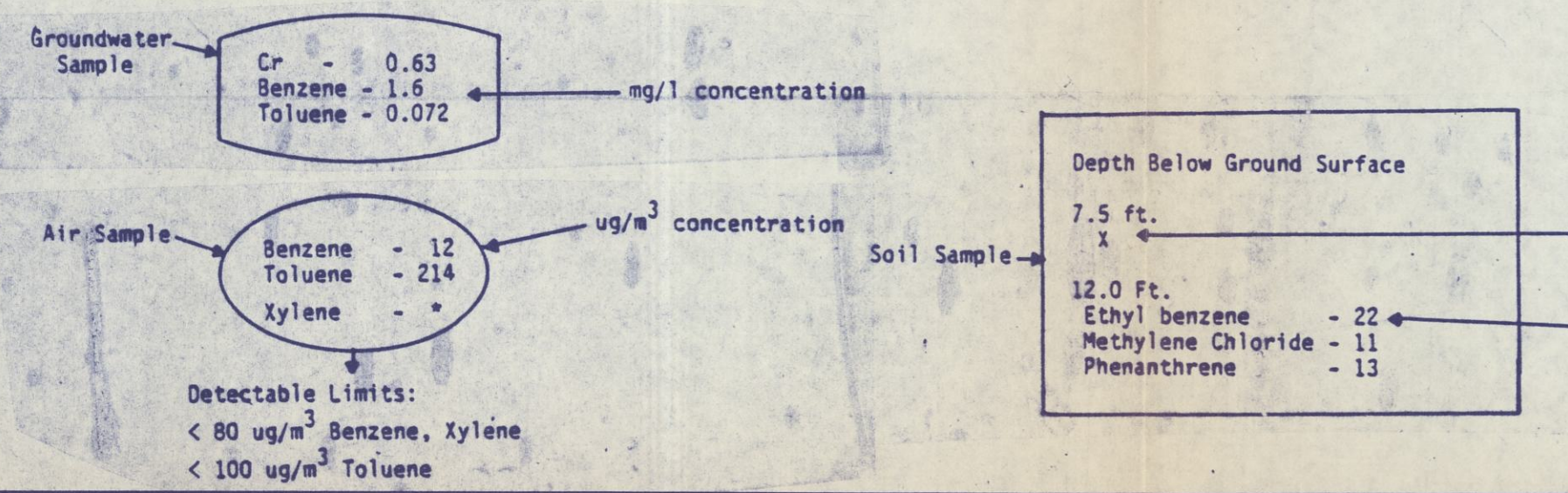
ANALYTICAL RESULTS

REVISIONS		DATE	BY
DR. BY S.A.M. DATE 8/84		CHD. BY	DATE 8/84
REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS		BY	DATE

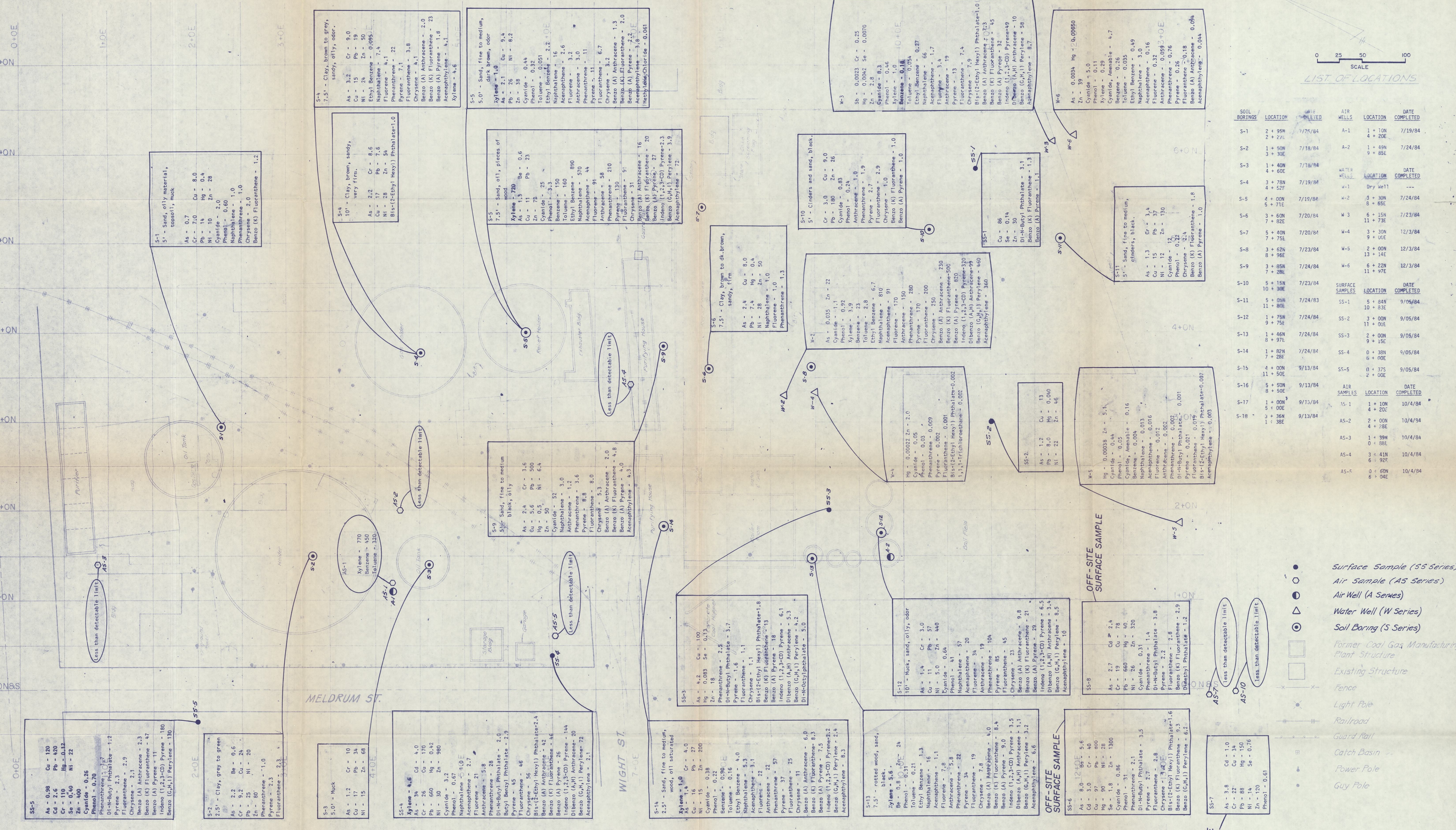
MICHIGAN CONSOLIDATED GAS COMPANY		9/84
STATION B		PROJECT NO. 20288
DETROIT, MICHIGAN		SHEET NO.

FIGURE 3

Note
B.M. #1 - B.S. Nail In N Side Light Pole
3+63E, 0+27N Elev 117.04



- Surface Sample (SS Series)
- Air Sample (AS Series)
- Air Well (A Series)
- Water Well (W Series)
- Soil Boring (S Series)
- Former Coal Gas Manufacturing Plant Structure
- Existing Structure
- Fence
- Light Pole
- Railroad
- Guard Rail
- Catch Basin
- Power Pole
- Guy Pole



Subsurface:

A total of 18 soil borings were completed on-site. Fourteen of these borings extend to the first encountered water surface. Four of the borings extend to 30 feet below existing ground surface or to 10-foot penetration of the first encountered clay layer. The soil borings were advanced with 8-inch hollow stem augers. Soil test samples were taken at 2-1/2 foot intervals to a depth of 10 feet and at 5-foot intervals to the end of the boring in accordance with procedures outlined in Standard Penetration Test (ASTM D-1586). In this test, a standard split barrel sampler is driven 18 inches into the soil with a 140-pound hammer falling 30 inches. Soil descriptions at individual boring locations are found in Supplemental Data. Actual boring locations are displayed in Figure 2.

Soil samples were retained for laboratory testing in two 40 ml volatile organic analysis vials that were packed tightly with soil to minimize air voids in the sample, and one solvent rinsed, baked, 500 ml amber glass bottle. After collecting the laboratory samples, the sampler was steam-cleaned before using at the next sample depth. Borings were terminated at the soil-water interface and were backfilled with excavated soil or a mixture of soil and bentonite. The auger and portions of the drill rig were steam-cleaned before proceeding to the next boring.

Excess soil and debris from the borings and drilling operation were sealed in barrels and transported to a Michigan Consolidated Gas Company facility for appropriate disposal.

Groundwater

A total of six groundwater sampling wells were drilled to determine groundwater flow direction and obtain a sample of the groundwater from each of the wells. Groundwater was encountered in five of the six boreholes. No groundwater was encountered at location W-1 completed in the northern portion of the site adjacent to Jefferson Avenue. Actual well locations are shown in Figure 2.

Groundwater sampling wells W-1, W-2 and W-3 consisted of a 2-inch galvanized steel pipe and a 5-foot stainless steel well screen and were set with one half of the screen in the saturated soil zone and one half in the unsaturated soil

zone. Placing the well point in this manner was done to obtain a water sample at the soil-water interface. Groundwater sampling wells W-4, W-5 and W-6 consisted of a 2-inch galvanized pipe and a 3-foot stainless steel well screen set in the saturated zone. Gravel packing was inserted around the pipe in the 4-inch annulus of the auger before the auger was pulled out of the ground to improve the intake properties of the well. Water samples were then collected with a teflon or stainless steel bailer and placed in containers as follows:

- 2 - One liter, solvent washed, baked amber glass bottles
- 2 - Forty ml volatile and organic vials filled with water without an air space
- 1 - One liter plastic bottle pretreated with nitric acid
- 1 - 500 ml plastic bottle pretreated with sulfuric acid
- 1 - 500 ml plastic bottle pretreated with sodium hydroxide

Each well was equipped with a flush mount locking cap or a locking cap mounted approximately two feet above the ground on the top of the well pipe. A master key lock was then fitted on the locking cap to prevent unauthorized entry.

Air

Air sampling was performed to determine any impact of the sites on the ambient air. Sampling locations were selected to establish background concentrations of selected organic compounds, maximum concentrations in areas of potential human contact, and concentrations exiting the sites. Sampling locations were altered when meteorological conditions, structural interferences, or other factors prohibited sampling in preferred locations. In that respect, areas adjacent to the Detroit River were not sampled due to restricted access at the time of the field sampling. A total of five ambient air samples were collected in the northern portion of the site. Samples collected in urban Detroit areas for Station A were used to determine background conditions.

Charcoal sorbent sampling tubes were employed to capture the selected organic compounds. The sampling media was placed at levels from two to five feet above the ground. Sampling was performed for one hundred and twenty minute periods at a nominal sampling rate of two hundred cubic centimeters per minute.

Subsurface:

Air wells were located based on visual judgement in the field of areas of worst coal tar contamination. The air wells were set in the same manner as the water wells, except the well point was placed in the unsaturated zone and a concrete cap was installed to prevent leakage from the well. A sampling valve was installed on top of each well and allowed to purge (valve open) for eight to twenty-four hours in order to remove ambient air introduced during the drilling operation. Each well was then sealed (valve closed).

Health and Safety Procedures

A comprehensive health and safety program was employed throughout field activities to protect the staff from potential hazards associated with coal tar related compounds. Ambient air levels of aromatic hydrocarbons were measured during drilling operations with Draeger style tubes and an HNU-PI 101 photoionizer.

Personnel protection was down-graded on the basis that a majority of sampling areas contained low levels of contaminants and that high level areas could be easily detected with field instrumentation. Standard personnel protection equipment consisted of rubber boots, gloves, and full length neoprene aprons. If ambient aromatic hydrocarbon levels exceeded 1-5 ppm or if coal tar was encountered, sampling activities were stopped momentarily. The sampling was resumed after respiratory and body protection was initiated (carbon filter respirators and PVC laminated tyvek suits, rubber gloves and boots).

TESTING METHODOLOGY

Prescreening

Prescreening of samples was conducted to identify which borings contained elevated levels of coal tar related organic compounds. Field and laboratory prescreening procedures were utilized. In the field, the individual borings were scanned with an HNU PI-101 photoionizer. The instrument functioned as a detector for volatile organic compounds and was calibrated to determine levels

of aromatic hydrocarbons as they volatilized from the samples. Using this method, a 1-10 ppm detection limit in the soil could be determined for benzene, toluene, ethyl benzene, and xylene.

Laboratory prescreening was conducted using a Turner III fluorometer. The polynuclear aromatic compound fraction (PNA's) of coal tar will produce intense fluorescence when exposed to ultraviolet light because of the conjugated ring structure present. A prescreening method was developed based on this property using a rapid solvent extraction. A 5 gram soil sample was taken with a clean spatula and placed in a 40 ml, solvent rinsed glass vial. Thirty milliliters of acetone was added and the vial was then capped and shaken for 15 seconds. After settling of the particulate fraction (15 minutes), an aliquot of the solvent was removed and analyzed in the fluorometer. The instrument was zeroed initially and in between samples with an acetone blank. Fluorometric readings are found in Supplemental Data.

Water, Soil and Air

The analytical program for environmental samples consisted of parameters given below:

- 1) Volatile organics, base/neutral extractables, heavy metals, cyanide, and total phenols on selected soil samples and all water samples; and
- 2) Benzene, toluene, and xylene on air samples.

The specific methodology for each parameter is detailed in the following sections.

Water:

Water samples were analyzed according to the methods outlined in Table 1.

Soil:

Soil samples were prepared for analysis according to EPA Solid Waste Protocols. Preparation methods are given in Table 2. Analytical methods for the prepared (digested, extracted, distilled, etc.) samples are the same as those given in Table 1.

TABLE 1
WATER ANALYTICAL METHODS

<u>Parameters</u>	<u>Description</u>	<u>Method #</u>
Volatile Organics	Purge and trap / GC/MS	624*
Base/Neutrals	Solvent extraction / GC/MS	625*
Cyanide	Distillation / automated colorimetric	335**
Phenols	Distillation / automated colorimetric	420**
Antimony	Digestion / atomic absorption	204.1**
Arsenic	Digestion / hydride	206.2**
Beryllium	Digestion / atomic absorption	210.1**
Cadmium	Digestion / atomic absorption	213.1**
Chromium	Digestion / atomic absorption	218.1**
Copper	Digestion / atomic absorption	220.1**
Lead	Digestion / atomic absorption	239.1**
Mercury	Digestion / cold vapor	245.1**
Nickel	Digestion / atomic absorption	249.1**
Selenium	Digestion / hydride	270.1**
Silver	Digestion / atomic absorption	272.1**
Thallium	Digestion / atomic absorption	279.1**
Zinc	Digestion / atomic absorption	289.1**

* Methods for Organic Chemical Analysis of Water, EPA, July 1982.

** Methods for Chemical Analysis of Water and Wastewater, EPA, 1979.

TABLE 2
SOIL SAMPLE PREPARATION METHODS

<u>Parameters</u>	<u>Description</u>	<u>Method #</u>
Volatile Organics	Head space	8.82*
Base/Neutrals	Soxhlet extraction	8.86*
Cyanide	Distillation	8.55*
Phenols	Distillation	510**
Metals	Acid Digestion	8.49*

* Methods for Organic Chemical Analysis of Water, EPA, July 1982.

** Methods for Chemical Analysis of Water and Wastewater, EPA, 1979.

Air:

Air samples were analyzed according to NIOSH procedures (P&CAM 127) using carbon disulfide desorption of the charcoal tube and gas chromatographic testing of the solvent for benzene, toluene, and xylene.

RESULTS OF INVESTIGATION

ANALYTICAL

The soil, subsurface air, and water samples collected at Station B contained concentrations of chemicals which were by-products from the coal gasification operations conducted in the old facilities or present in the raw process materials. Volatile liquids, such as benzene, toluene, ethyl benzene, xylene and phenol, in addition to coal tar solids such as polynuclear aromatic hydrocarbons (PNA's), are present on-site in low to moderate concentrations. These substances were formed as the molecular structure of coal was broken down in the gasification process.

The soil, subsurface air, and water samples indicate that the site exhibits low to moderate levels of contamination. For example, benzene, toluene, xylene, phenol, and certain PNA's, which are suspected carcinogens, were found in low to moderate concentrations. Benzene was found in four of the five groundwater samples (23.0 mg/l at location W-2, 0.18 mg/l at W-3, 0.004 mg/l at W-5, and 0.26 mg/l at location W-6) and in one subsurface soil sample (150 mg/kg at S-5). Xylene, toluene and ethyl benzene were detected in each groundwater sample from W-2, W-3 and W-6. Of these three wells, W-2 contained the highest concentrations of xylene (3.9 mg/l), toluene (2.8 mg/l), and ethyl benzene (6.7 mg/l). Phenols were detected in all five wells (W-2 at 0.92 mg/l, W-3 at 0.46 mg/l, W-4 at 0.03 mg/l, W-5 at 0.05 mg/l, and W-6 at 0.11 mg/l). Pyrene, naphthalene, phenanthrene, and fluoranthene, which are characteristic PNA's of the coal gasification process, were found at various values in each of the five groundwater samples. The groundwater sample data appear to indicate that samples from W-2 and W-3 contained contaminants in excess of their solubility limits (i.e., floatable fractions), while samples from W-4, W-5 and W-6 probably indicate a more representative concentration of contaminants found in solution in the groundwater under the site. PNA concentrations in the on-site surface soil samples did not exceed 180 mg/kg (location SS-5), while subsurface soil samples did not exceed 570 mg/kg (location S-5).

For reference, benzene and PNA's naturally occur in crude petroleum and are refined into a variety of fuels and solvents. Gasoline may contain up to 5%

benzene (50,000 mg/l). PNA's are also formed by simple combustion reactions and are commonly found in soot, smoke, ash, asphalt, road tar, creosote wood preservatives, and even roasted and grilled foods. Natural background readings for many occurring PNA's are in the 0.1 to 10 mg/kg range.

Cyanide, which is created by pyrolytic reactions in the coal gas process, was detected in various concentrations in groundwater, surface and subsurface soil samples taken from Station B. The highest values for total cyanide found on-site are as follows: 8.3 mg/l at W-3, 3.2 mg/kg at SS-4, and 52 mg/kg at S-9.

In addition, ambient surface air samples taken to detect volatilized emissions from benzene, toluene and xylene found in the subsoil, yielded no detectable levels. However, subsurface air samples taken in air well A-1 did identify detectable levels of benzene, toluene and xylene.

Various levels of heavy metals were detected in groundwater, surface, and subsurface soil samples. These materials are normal constituents in the concentrated residues left behind by the gasification combustion process. Chromium, copper, lead and zinc are the metals of interest found on-site. For example, a surface soil concentration of 980 mg/kg for zinc was detected at SS-4, while a subsurface soil value for zinc of 440 mg/kg was found at location S-12, and a groundwater concentration of 0.25 mg/kg for chromium was recorded at W-3.

The results of soil, water and air samples collected at Station B are summarized in the following sections. A map has also been prepared (Figure 3) which illustrates the locations and concentrations of various chemical contaminants found on-site. The detailed analytical results are tabulated by location in the Supplemental Data volume.

Air

The results of ambient air samples collected from the surface area of the site and background areas revealed no detectable levels of benzene, toluene and xylene. The reader will notice that the detection limits for benzene, toluene

SCOPE OF WORK

METHODOLOGY

Compilation and Review of Readily Available Data

Readily available data concerning Station B was obtained from Michigan Consolidated Gas Company, the City of Detroit, and the Detroit Public Library. Data compiled included Sanborn Insurance mapping of the site, plant operating dates and process descriptions, and site layout drawings. Governmental publications, including USGS topographic maps, geological history of Wayne County, and well drillers' logs, were obtained and reviewed for information pertaining to area geology.

Survey

The site was surveyed by Williams & Works' survey crews to establish locations of existing facilities and provide a grid base to accurately locate sampling points. Vertical elevations were referenced to City of Detroit datum. Horizontal control was established using the center line of Meldrum Street as 0+00 North-South control line.

Soils

Surface:

A total of five surface soil samples were collected and analyzed. Surface samples collected in urban Detroit areas for Station A were used to establish background conditions. Surface soil samples were acquired on-site in areas of potential human contact. The samples were obtained with a stainless steel spoon from the top two inches of the soil surface. The sampling spoon was thoroughly washed with soap and water between sampling points. Soil samples were retained for laboratory analysis in two volatile organic vials and one 500 ml amber bottle. Actual sample location points are shown in Figure 2.

and xylene are different than the background samples taken in relation to Station A and the on-site samples taken at Station B. Detection limits for Station B samples are lower than background limits due to a refinement in sampling and laboratory analytical procedures.

Only air well location, A-1 near Meldrum Street, contained detectable levels of benzene, toluene and xylene at 450 ug/m^3 , 320 ug/m^3 , and 770 ug/m^3 , respectively. These values represent a subsurface sample from an air well set five feet below ground surface in the unsaturated soil zone. Surface sample locations AS-2 and AS-5, which are in close proximity to A-1, verify the lack of ambient air readings for benzene, toluene and xylene above the detectable limits. The subsurface air values recorded from sample location A-1 are probably attributable to a subsurface area containing coal tar or other waste residue.

Groundwater

The laboratory results of water samples collected at wells W-2, W-3, W-4, W-5 and W-6 are given in the Supplemental Data volume and illustrated with their locations on Figure 3. The Safe Drinking Water Act (SDWA) limits and Guidelines for Drinking Water Quality Parameters are presented in Appendix B for reference and information.

Analytical data from W-2, W-3, W-4, W-5 and W-6 indicate that the groundwater under the site is contaminated and is not suitable for a drinking water supply. The groundwater sample data suggests that samples from W-2 and W-3 contained contaminants in excess of their solubility limits; i.e., floatable fractions. A visible layer of oil was noted in both W-2 and W-3 samples. This would account for the high concentrations of PNA's as the measured levels are in excess of the water solubility of these compounds. W-2 contained concentrations of benzene (23.0 mg/l), ethyl benzene (6.7 mg/l), toluene (2.8 mg/l), xylene (3.9 mg/l), phenol (0.92 mg/l), and many base neutral extractable organic compounds, such as naphthalene (810 mg/l), phenanthrene (280 mg/l), benzo(a)pyrene (820 mg/l), benzo(k)fluoranthene (500 mg/l), benzo(a)anthracene (230 mg/l), pyrene (170 mg/l), and fluoranthene (200 mg/l). W-3 contained low concentrations of benzene (0.18 mg/l), ethyl benzene (0.27 mg/l), xylene (1.0 mg/l), toluene (0.054 mg/l), phenol (0.46 mg/l), and concentrations of various

PNA's [naphthalene (66 mg/l), benzo(k)fluoranthene (45 mg/l), benzo(a)pyrene (32 mg/l), pyrene (13 mg/l), and anthracene (19 mg/l)]. W-4 contained a low level of phenol (0.03 mg/l) and several PNA compounds with concentrations below 0.009 mg/l (phenanthrene). W-5 contained low level concentrations of benzene (0.004 mg/l), phenol (0.05 mg/l), and various PNA's, such as naphthalene (0.013 mg/l), acenaphthalene (0.016 mg/l), pyrene (0.021 mg/l), and fluoranthene (0.019 mg/l). Heavy metals were detected in all five well samples. W-2 (zinc at 22.0 mg/l), W-3 (chromium at 0.25 mg/l and mercury at 0.0042 mg/l), W-5 (zinc at 5.1 mg/l), and W-6 (zinc at 39 mg/l) revealed concentrations which were above the allowable levels for safe drinking water.

W-2, W-3, W-4, W-5 and W-6 showed concentrations of total cyanide at 1.1 mg/l, 8.3 mg/l, 0.05 mg/l, 0.44 mg/l, and 5.0 mg/l, respectively. The cyanide found in the groundwater is thought to be composed of ferric ferrocyanide and cyanides which are amenable to chlorination. These amenable cyanides have the potential to be more toxic than ferric ferrocyanide. Ferric ferrocyanide is a stable form of cyanide which is not highly toxic. This assumption is based upon specific tests of the groundwater at this site and previous data collected at other coal gasification plant sites. Results from W-5 and W-6 showed cyanides amenable to chlorination to be present in concentrations of 0.16 mg/l and 4.7 mg/l, respectively. This data implies that even though most of the cyanide in the soil is ferric ferrocyanide, there is some available cyanide in the soil being released to the groundwater.

The concentrations for benzene, xylene, toluene, ethyl benzene, cyanide, phenol and various PNA compounds detected in the groundwater samples could cause human health concerns if consumed by humans because they are present in concentrations above the National Interim Primary Safe Drinking Water Standards or USEPA or USPHD guidelines for Water Quality Criteria levels for long-term human health exposures. The presence of these substances at the concentrations noted render the groundwater beneath the site not acceptable for drinking water. However, because the groundwater is not an identified source of drinking water, human health effects are not anticipated.

Wells W-3, W-5 and W-6 are downgradient from W-2 and W-4. The groundwater gradient is toward the Detroit River in an east-southeasterly direction, from W-2 to W-6. Present water quality data from W-4, W-5 and W-6 appear to confirm

that migration of contaminants from upgradient areas of soil contamination are entering the groundwater. W-4, W-5 and W-6 appear to be more representative of the actual groundwater contaminant concentrations than W-2 and W-3. The data further suggests that the contaminants have the potential to move off-site toward the river. W-4, W-5 and W-6 contain representative organics and PNA's in the parts per billion (ppb) range. This is approximately 1,000 times higher than the parts per trillion (ppt) range one might expect to find in some groundwaters of the area.

W-4, W-5 and W-6 confirm that detectable concentrations of various volatile organics, organics, inorganics, and PNA compounds are migrating off the site and are potentially reaching the Detroit River at the groundwater and surface water interface. It is not known if the floatable organic and inorganic materials detected in W-2 and W-3 are moving off-site. Likewise, it is not certain that, should the floatables be leaving the site, they are actually reaching the Detroit River. The potential effects of these contaminants of concern entering the Detroit River will be examined in a later section of this report entitled "Effects upon the Detroit River."

Soils

The analytical results of surface and subsurface soil samples are listed in the Supplemental Data and illustrated along with locations in Figure 3.

In general, the soils show a low to moderate degree of impact from gasification operations, except for small concentrated areas within or near the facilities of the old plant. With the exception of the five foot sample taken in the relief holder (S-5), the surface soil sample taken at the northeastern corner of the site (SS-1), and subsoil samples at S-9 and S-11, the levels of contaminate cannot be distinguished from the bituminous samples (asphalt) or the background surface soil samples collected from the urban Detroit area. The majority of the on-site surface samples were found to be well within a 5 to 10 fold range of naturally occurring background levels as shown in Table 3.

The relief holder sample, S-5, contained elevated levels of benzene (150 mg/kg), toluene (160 mg/kg), ethyl benzene (890 mg/kg) and xylene (720 mg/kg), in addition to PNA's in the range of 2.3-570 mg/kg. With the exception of naphthalene, the soil PNA's were in the same range as the materials detected in

asphalt samples at SS-4 and SS-5. Levels of benzene and related solvents were all less than 100 mg/kg for the remainder of the soil sample analyzed at the site. Other samples such as S-12 and S-14 contained concentrations of PNA materials above the background samples mentioned earlier, but below the asphalt materials examined. Both of these soil samples contained visible oil.

TABLE 3
AVERAGE CONCENTRATIONS IN RURAL SOILS FOR HEAVY METALS

Antimony (Sb) ^a	10 mg/kg
Arsenic (As) ^a	10 mg/kg
Beryllium (Be) ^a	6 mg/kg
Cadmium (Cd) ^b	0.7 mg/kg
Chromium (Cr) ^b	42 mg/kg
Copper (Cu) ^b	10 mg/kg
Lead (Pb) ^b	14 mg/kg
Mercury (Hg) ^a	0.3 mg/kg
Nickel (Ni) ^b	18 mg/kg
Selenium (Se) ^a	2 mg/kg
Silver (Ag) ^a	1.2 mg/kg (Detection Limit)
Thallium (Tl) ^a	2 mg/kg
Zinc (Zn) ^b	49 mg/kg

^a Hazardous Waste Land Treatment,
EPA, SW-874, April 1983.

^b Unpublished Data, Rural Michigan Soils,
Dr. Lee Jacobs, Department of Crop and Soil Sciences,
Michigan State University, December 1984.

Subsurface soil samples taken at locations S-9 and S-11 yielded cyanide values of 52 ppm and 12 ppm, respectively. These values are in excess of the background data collected for the Detroit area and any other location sampled on-site. Both samples were taken at the five-foot depth. No values for cyanide were detected from any of the surface soil samples with the exception of the asphalt samples taken at locations SS-4 and SS-5. Both of the asphalt samples yielded relatively low values for cyanide, 3.2 ppm and 0.26 ppm, respectively.

TOXICOLOGY

The data presented in this report has been reviewed by a certified toxicologist, Dr. Jay Goodman of Michigan State University. Based upon his review, it appears that no significant hazards to human health exist at Station B. However, the presence of elevated concentrations of chromium (W-3), mercury (W-3), zinc (W-2, W-5, W-6), and moderate levels of benzene, toluene, ethyl benzene, xylene, phenols, naphthalene and other PNA's in the groundwater (W-4, W-5, W-6) render it not acceptable for a source of drinking water.

Hydrological data confirms that the groundwater under the site is connected to the Detroit River. Furthermore, the groundwater sampling results indicate that contaminants in the groundwater have a potential of entering the Detroit River. The range of contaminant types and their worst case concentrations found in the groundwater may pose a concern to the aquatic life when the contaminated groundwater is released to the Detroit River ecosystem.

Surface soil samples taken on-site reveal concentrations of organic and inorganic substances which are within a 5 to 10 fold range of typical urban soils or background soil samples taken from urban Detroit locations. The presence of these substances in the detected concentrations do not pose a public health concern. Likewise, the presence of inorganic substances, volatile organics, and PNA compounds found in the subsurface soils do not pose a human health or environmental concern because they are either well contained and not available for human contact or are found in low concentrations.

Air

The ambient air surface samples collected revealed levels to be non-detectable for benzene, toluene, and xylene at every sampling location. One subsurface air sample indicated detectable levels for the three compounds. This sample was taken near Meldrum Street (Location A-1). While subsurface detectable amounts of benzene, toluene, and xylene were encountered, their levels are over 100 times below the Occupational Safety and Health Administration (OSHA) 8-hour Threshold Limit Value (TLV) and pose no associated hazard in terms of human exposure. These results clearly show that subsurface concentrations of

volatile organics are well contained, and not migrating to the ambient air in detectable or harmful quantities.

Groundwater

Cyanide:

Total cyanide was detected in the groundwater from well W-2 at 1.1 mg/l, W-3 at 8.3 mg/l, W-4 at 0.05 mg/l, W-5 at 0.44 mg/l, and W-6 at 5.0 mg/l. The levels detected in the groundwater from W-2, W-3, W-5 and W-6 are above the National Interim Drinking Water Standard of 0.2 mg/l. Cyanide is potentially a very toxic compound. However, in order for toxicity to occur, one must receive a sufficient dose of cyanide compound which, following ingestion, is able to release the cyanide portion so that it may interact with vital components of the cells of the body. Not all of the cyanide containing compounds readily release their cyanide portions. Sodium cyanide is one which can readily release the cyanide portion following ingestion. A dose of approximately 50 mg to 60 mg could be lethal to a person. If the cyanide in the groundwater were complexed as sodium cyanide, a person would have to drink from seven to eight liters of water from well W-3 at 8.3 mg/l of total cyanide to receive a lethal dose. This is an estimate for a "typical" 70 kg man. The estimated amount would be proportionally lower for a child. The EPA estimates that the average adult human consumes approximately 2 liters of water per day. By consuming 2 liters of groundwater from location W-3, an individual would receive approximately 25% of a lethal dose of cyanides if it were in the most toxic form.

The analytical method employed for W-4, W-5 and W-6 measured both total cyanide and cyanide amenable to chlorination. The analysis run on W-2 and W-3 only analyzed for total cyanide. W-4 contains no detectable amenable cyanides. W-5 was found to contain 0.16 mg/l of cyanide amenable to chlorination, while W-6 contained 4.7 mg/l. Based upon this additional laboratory analyses and experience in analyzing results from similar coal gasification process facilities, it is believed that the cyanide present in the groundwater under and downgradient from Station B is in both a ferric ferrocyanide form and a form which is amenable to chlorination. This means that some of the cyanide in the groundwater is either a free cyanide ion or in a complexed form that is disassociated

and/or soluble in water; i.e., sodium or potassium cyanides. This available form of cyanide is more toxic than the more stable ferric ferrocyanide. Regardless of the form of cyanide present in the groundwater, the concentrations are such that it is not considered "safe" to drink.

A cyanide concentration of 8.3 mg/l in an available form directly entering into the Detroit River could affect the aquatic ecosystem of the river. However, analytical results suggest that only a portion of cyanide in the groundwater is in an available form. W-6 data indicated that this sample contained 4.7 mg/l of cyanide amenable to chlorination. Even if all of the cyanide in the groundwater was in an available form (which it is not) and even to a worst case concentration of 8.3 mg/l, it is anticipated that the mixing action of the river upon the groundwater discharge would result in a concentration of cyanide at the outer edge of the mixing zone that is below analytical detection limits. This issue will be more fully discussed in the section of this report entitled "Effects Upon the Detroit River".

Benzene:

A moderate level of benzene was detected in wells W-2 (23.0 mg/l), W-3 (0.18 mg/l), W-5 (0.004 mg/l), and W-6 (0.26 mg/l). The measured values for all of these wells except W-5 are above the EPA water quality criteria level for human health exposure of 0.0066 mg/l (USEPA 1980b Ambient Water Quality Criteria for Benzene, EPA 440/5-80-18). Benzene is a chemical which is known to have the potential to cause cancer in people. Benzene occurs in fruit, fish, vegetables, nuts, beverages, and eggs. It has been estimated that an individual could ingest up to 0.25 mg/day of this compound. In addition, the benzene concentration in the air in an urban environment is approximately 50 ug/m³. This could result in an individual absorbing approximately 0.50 mg to 0.60 mg per day from the air. If a person drank two liters of water per day from W-2 (the EPA assumes than an individual drinks this amount per day) containing benzene at a concentration of 23.0 mg/l, this would amount to the ingestion of 46.0 mg/day of benzene. The ingestion of an additional 46.0 mg per day of benzene would represent approximately a 6,000% increase over the "background dose" received from ambient urban air intake and food ingestion. This would represent a significant increase in exposure to a known human carcinogen. Water containing benzene at a concentration of 23.0 mg/l would most definitely not be acceptable for a drinking water supply. It is, however, felt that the

concentrations of benzene detected in W-2 are not representative of the benzene groundwater contamination. It is suspected that W-6 (0.26 mg/l) is more representative of the actual groundwater contamination.

Benzene becomes a concern in groundwater at these levels only if it might be consumed in drinking water. As previously mentioned, the groundwater on-site or downgradient from the site is not known to be used as a drinking water source.

Benzene in the groundwater entering the Detroit River at the estimated 23.0 mg/l could cause acute effects to the aquatic ecosystem. Acute toxicity concentrations of benzene for aquatic life is in the order of 5.3 mg/l (USEPA 1980b). In the past, the MDNR has regulated point source surface water discharges of benzene at 0.024 mg/l in an attempt to protect aquatic organisms from chronic effects. The current validity of this value is presently unknown. As discussed above, it is suspected that a more representative value for benzene in the groundwater is probably similar to the 0.26 mg/l detected in W-6. However, worst case groundwater containing 23.0 mg/l that discharges to surface waters may not cause chronic effects upon the aquatic ecosystem of the Detroit River. It is suspected that the mixing action of the river would dilute the 23.0 mg/l concentrations of benzene at the outer edge of the hypothetical mixing zone to a level below analytical detection limits. This issue will be more fully discussed in the section of this report entitled "Effects Upon the Detroit River".

Xylene:

A low concentration of xylene was identified in the water samples from wells W-2 (3.9 mg/l), W-3 (1.0 mg/l), and W-6 (0.29 mg/l). Although no regulatory criteria have been established, xylene may pose a chronic human health concern when ingested water has a concentration of approximately 1 mg/l. Xylene at a concentration of 3.9 mg/l (3.9 ppm) is not acceptable for a drinking water supply according to the current policy of the State of Michigan Public Health Department. It is suggested that the 3.9 mg/l value for xylene in the groundwater is not representative of the groundwater contamination by xylene. It appears that the W-6 concentration of 0.29 mg/l is probably more representative.

Xylene in surface waters at concentrations of 3.9 mg/l may not cause acute effects to organisms in the aquatic ecosystem. The detected level in the groundwater (3.9 mg/l) is below the LC_{50} concentration of 17 mg/l for goldfish. However, in the past, the MDNR has regulated surface water discharges of xylene at 0.040 mg/l in an attempt to protect aquatic organisms from chronic effects. The current validity of this value is unknown. It is estimated that, should the detected level of 3.9 mg/l of xylene be reaching the Detroit River, the mixing action of the river would dilute the concentration of xylene at the outer edge of the hypothetical mixing zone to a level below analytical detection limits. This issue will be discussed in a later section of this report (See "Effects Upon the Detroit River").

Ethyl Benzene:

Ethyl benzene was detected in W-2, W-3, and W-6 at concentrations of 6.7 mg/l, 0.27 mg/l, and 0.49 mg/l, respectively. Ethyl benzene can pose a chronic human health concern when consumed in drinking water at approximate concentrations of 1.4 mg/l (USEPA 1980d, Ambient Water Quality Criteria for Ethyl Benzene - EPA-440/5-80-048). Ethyl benzene at a concentration of 6.7 mg/l in groundwater would not be acceptable for a drinking water supply according to the current policy of the State of Michigan Public Health Department. It is suggested that the 6.7 mg/l value for ethyl benzene in the groundwater is not representative of the groundwater concentration of ethyl benzene beneath the site. The W-6 value of 0.49 mg/l is probably more representative.

Ethyl benzene in surface waters at the concentration detected in W-2, W-3, and W-6 would not cause acute effects to organisms in the aquatic ecosystem. Reported acute toxicities for ethyl benzene range from 75 mg/l (acute LC_{50} for Daphnia magna) to 97 mg/l (LC_{50} for the guppy) to 45 mg/l (LC_{50} for the fathead minnow). It is estimated that, should the detected levels of ethyl benzene be reaching the Detroit River, the mixing action of the river would dilute the concentration of ethyl benzene at the outer edge of the mixing zone to a level below analytical detection limits. This topic will be discussed in another section of this report entitled "Effects Upon the Detroit River".

Toluene:

Toluene was detected in W-2, W-3, and W-6 at concentrations of 2.8 mg/l, 0.054 mg/l, and 0.035 mg/l, respectively. Toluene can pose a chronic human health concern when consumed in drinking water at approximate concentrations of 14 mg/l (USEPA 1980i, Ambient Water Quality Criteria for Toluene EPA 440/5-80-75). Toluene, at a concentration of 2.8 mg/l in groundwater, would probably not be acceptable for a drinking water supply according to the current policy of the State of Michigan Public Health Department. It is suggested that the 2.8 mg/l value for toluene in the groundwater is not representative of the groundwater contamination by toluene. It appears that the W-3 value of 0.054 mg/l is probably more representative.

Toluene in surface waters at the concentrations detected in W-2 would not cause acute effects to organisms in the aquatic ecosystem. Reported acute toxicities for toluene range from 137 mg/l (acute mean LC_{50} for Daphnia magna) to 59.3 mg/l (LC_{50} for a guppy, Docilla reticulata) to 17.5 mg/l (LC_{50} for bluegill sunfish). In the past, the MDNR has regulated point source surface water discharges of toluene at 0.100 mg/l in an attempt to protect aquatic organisms from chronic effects. The current validity of this value is unknown. It is suggested that, should a concentration of 2.8 mg/l of toluene be reaching the Detroit River, the mixing action of the river would dilute the concentration of toluene at the outer edge of the mixing zone to a level below analytical detection limits. Additional discussion of this topic is covered in the section of this report entitled "Effects Upon the Detroit River".

Phenol:

A low concentration of phenol was identified in the water samples from Wells W-2 (0.92 mg/l), W-3 (0.46 mg/l), W-4 (0.03 mg/l), W-5 (0.05 mg/l), and W-6 (0.11 mg/l). Phenols can pose a chronic human health concern when ingested water has a concentration of 0.001 mg/l, as set forth in the MDPH Drinking Water Quality Criteria for Human Health. Phenol at concentrations between 0.03 mg/l to 0.92 mg/l are not acceptable for drinking water. The detected concentration of phenols would pose a human health problem if the groundwater under the site were used for human consumption. However, the groundwater is not a

source of drinking water and, to this extent, it poses no significant hazard to human health.

The detected levels in the groundwater (0.92 mg/l) is above the level which the MDNR has previously regulated as being allowable for point source surface water discharges (0.73 mg/l). It is estimated that, should this low level of phenol be reaching the Detroit River, the mixing action of the river would dilute the concentration at the outer edge of the hypothetical mixing zone to levels below analytical detection limits. This topic will be covered in more detail in the section of this report entitled "Effects Upon the Detroit River".

PNA's:

The concentration of the various PNA compounds detected in the groundwater samples from W-2 are almost all in excess of their solubility limits in water. Most PNA solubility limits are in the range of 40-80 mg/l. It is this fact that suggests that the values detected in W-2 are not representative of the actual groundwater concentration of the PNA compounds. It appears that W-4, W-5, and W-6 are more representative of the groundwater values for PNA's. W-6 contained PNA values, such as naphthalene (3.0 mg/l), phenanthrene (0.76 mg/l), pyrene (0.26 mg/l), and benzo(a)anthracene (0.094 mg/l). These PNA concentrations could cause chronic human health concerns because they are present in concentrations above the levels which may result in incremental increase of cancer risk over a lifetime (as estimated at the excess occurrence of one in one million; i.e. 10^{-6}). The corresponding criteria for PNA's as a class at 10^{-6} is 0.0000028 mg/l. A PNA concentration of 3.0 mg/l for naphthalene and the others found in the groundwater are not acceptable for drinking water. The groundwater samples contained PNA's in the parts per million (ppm) and the parts per billion (ppb) concentration range. One might expect to find some of these chemicals in the parts per trillion (ppt) range; i.e., in concentrations approximately 1,000 to 10,000 times lower than those observed here. The PNA concentrations are not a cause for human health concern because the groundwater beneath and downgradient from the site is not a source of drinking water. The data presented in the "Effects Upon the Detroit River" section of this report also indicates that, even though low levels of PNA's may be reaching the Detroit River, their concentrations at the outer edge of the hypothetical

mixing zone would not exceed analytical detection limits. For further discussion of this topic, see the section on "Effects Upon the Detroit River".

PNA concentrations in the ppm range could pose a chronic long-term concern to sensitive aquatic life if biologically significant concentrations were reaching surface waters. The data discussed in the "Effects Upon the Detroit River" section of this report suggests that the PNA's entering the Detroit River would be below analytical detection limits at the outer edge of the hypothetical mixing zone. This topic is further discussed in the "Effects Upon the Detroit River" section of this report.

Heavy Metals:

The water analysis results for W-2, W-3, W-5, and W-6 showed elevated levels of inorganic heavy metals. W-2 detected zinc at a concentration of 22.0 mg/l which is above the recommended EPA water quality guidelines for drinking water of 5.0 mg/l. W-3 contained chromium at a concentration of 0.25 mg/l which is above the SDWA criteria of 0.05 mg/l. W-3 also contained mercury at a concentration of 0.0042 mg/l which is above the SDWA Drinking Water Standard of 0.002 mg/l. W-5 contained zinc at 5.1 mg/l which is just above the SWDA criteria level of 5.0 mg/l. W-6 also contained zinc at a concentration of 39 mg/l which is above the recommended EPA water quality guidelines for drinking water of 5 mg/l. These concentrations in the groundwater are attributable to the leaching of waste materials deposited at the site. Human health concerns from these concentrations in the groundwater are not significant as long as the groundwater is not used as a drinking water source.

Heavy metals found in the groundwater may be migrating off-site in a down-gradient direction and into the Detroit River. Heavy metals discharged to surface waters when in biologically significant concentrations can have toxicity effects upon aquatic organisms. However, based upon dilution calculations for chromium, mercury, and zinc, it is suggested that the resultant concentrations of these metals at the outer edge of the hypothetical mixing zone would be at a level below analytical detection limits. This issue is further discussed in the "Effects Upon the Detroit River" section of this report.

Soils

Surface soil sample analysis data indicate various levels of PNA compounds. The concentrations of these materials are in a range that are not toxic to humans or ecological resources. Most of the values recorded are in the 5 to 10 fold range of normal background levels. The presence of the identified PNA's in the surface soil at the reported concentrations are not a health concern to the workers on-site or to those individuals who may use the site.

A level of total cyanide of 3.2 mg/kg was detected in the SS-4 surface soil sample collected at Station B. Information on coal gas manufacturing processes suggests the cyanide is in the form of Prussian Blue (ferric ferrocyanide) which is a stable form and not highly toxic. Using a conservative approach and assuming the sample contained only free cyanide (the most toxic form), an adult would have to ingest over 20 pounds of surface soil for toxic effects to be manifested. This possibility is highly remote and consequently, the presence of cyanide at the 3.2 mg/kg level does not pose a significant hazard.

Subsurface soils contain low to moderate levels of PNA's, volatile organics, and heavy metals. Elevated levels for naphthalene, pyrene, fluoranthene, benzo(a)pyrene, fluoranthene, benzo(k)fluoranthene, benzene, toluene, ethyl benzene, xylene, zinc, lead and copper have been recorded. These materials are located beneath 2.5 to 10 feet of soil and are not accessible to humans or wildlife species. Only should these soils be disturbed or excavated could the low to moderate concentrations of contaminants come into contact with human or animal populations. Exposure at these concentrations could be significant due to their relatively moderate toxicity effects.

GENERAL GEOLOGY

Regional Geology

The geology of Wayne County consists of glacial deposits overlying bedrock of the Michigan Basin. The thickness of the glacial drift ranges from 390 feet in the Defiance Moraine Complex in the northwest corner of the county to 20 feet in the southwest corner. The topography of the county follows this trend also, with a regional slope from the northwest toward the southeast. The majority of

the county is characterized by gently sloping glacial lake plain. This plain consists of lacustrine sands and gravels which mark former glacial lake beaches or stream coarses, and lacustrine clay and silt marking deeper areas of the glacial lake.

Station B is located in an area of lacustrine clays and silts (Farrand & Bell, 1982). These sediments are described by Farrand & Bell as follows:

"Gray to dark reddish brown, varied in some localities, chiefly underlies extensive, flat, low-lying areas formerly inundated by glacial Great Lakes, but also occurs in separate, small lake basins, includes small areas of lacustrine sand and clay-rich till."

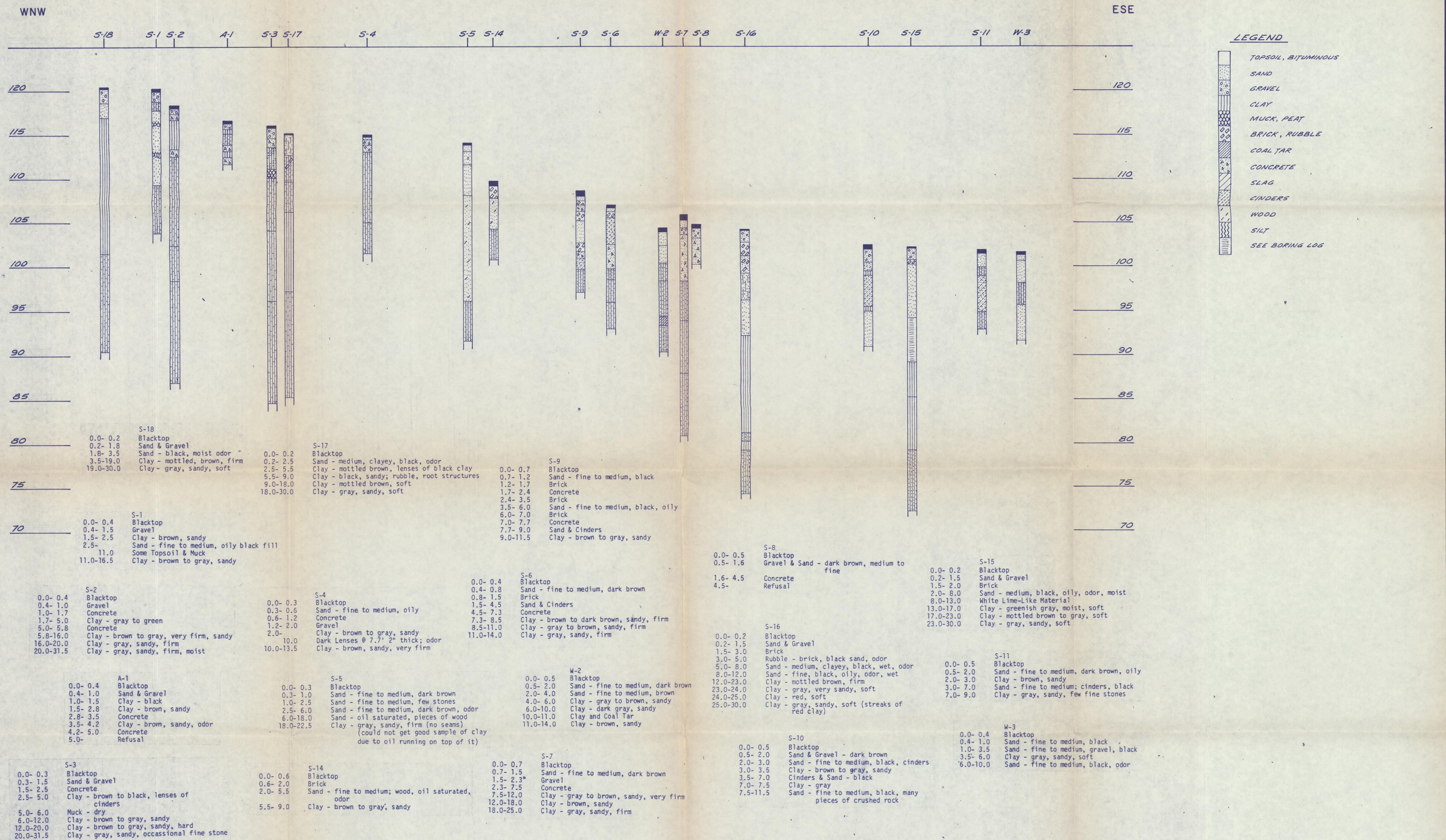
Well logs from the area (Supplemental Data) support this soil characterization. The thickness of these glacio lacustrine deposits in this area range from 120 to 170 feet. A well log from the immediate area (Michigan National Armory Well 1935, Supplemental Data) indicates the presence of 70 feet of clay above a fine sand deposit. The total drift thickness is approximately 150 feet.

The drift sediments are underlain by bedrock of the Michigan Basin. Shale of the Traverse Group underlies the sediments of this site.

Local Geology

Soil boring and water well logs from the Station B site (Supplemental Data) further support the lacustrine clay conditions described previously. Overlying this "natural" clay surface are various types of fill, primarily fine to medium sands but also including sandy clays, gravel, concrete, wood, cinders, bricks, and rubble. Cross sections of the site (Figure 4) illustrate the random nature of these fill deposits.

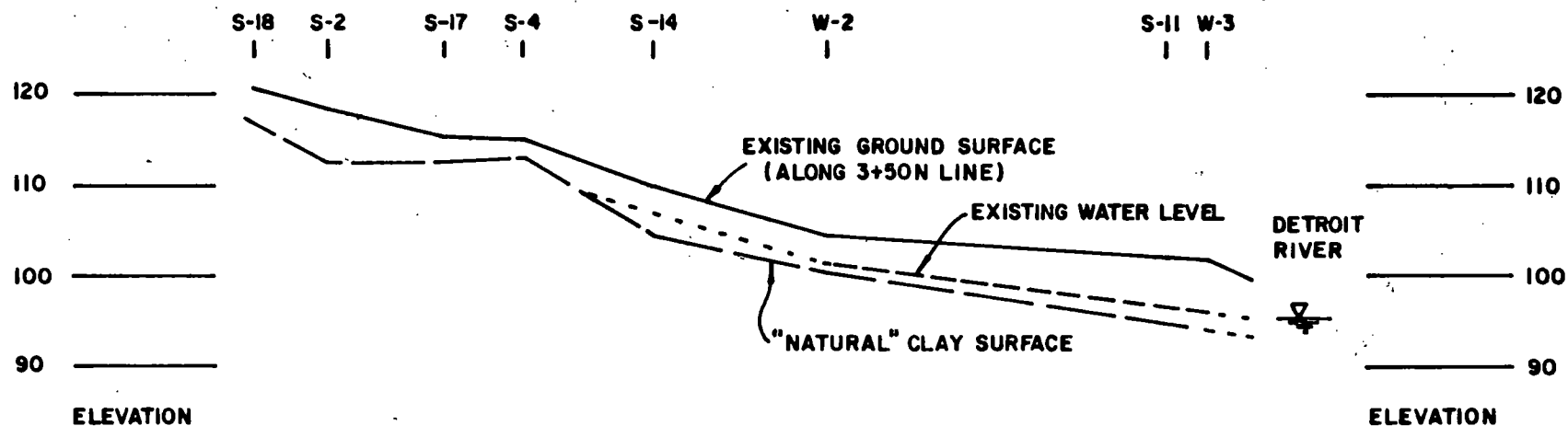
The elevations of the "natural" clay surface (Figure 5) indicate this surface slopes toward the Detroit River. The gradient of this clay surface is between one and two percent. The terraces of the clay surface indicate that it represents previous erosional surface formed when the post glacial Detroit River occupied a broader channel which included much of the area under investigation.



SUBSURFACE CROSS SECTIONS

FIGURE 4

REVISIONS DR. BY A.P. DATE 10/84 CHD. BY DATE		EDI ENGINEERING & SCIENCE ENGINEERS / GEOLOGISTS / BIOLOGISTS / CHEMISTS 611 CASCADE W. PKWY. S.E. GRAND RAPIDS, MI 49506 (616) 942-0970	MICHIGAN CONSOLIDATED GAS COMPANY STATION B DETROIT, MICHIGAN	DATE 10/84
REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS BY DATE				PROJECT NO. 20288
				SHEET NO. /



SCALE 1" = 20' VERTICAL, 1" = 200' HORIZONTAL
 VERTICAL EXAGGERATION = 10 x

MICHIGAN CONSOLIDATED GAS CO.

FIGURE 5

GENERAL CROSS SECTION

OCT. 1984

20288

Hydrogeology

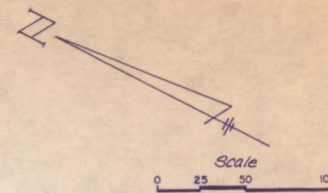
All of the on-site soil borings which penetrated to a sufficient depth encountered natural clay deposits. As mentioned previously, the Michigan National Armory Well 1935 indicates that these lacustrine clay deposits persist down to approximately 70 feet below which there is roughly 80 feet of fine sands. These sands may or may not be part of a deep regional aquifer.

The water in the surface materials at Station B is a small perched saturated zone. The source of the water is infiltration of rainfall into the fill materials. The water levels in wells W-2 through W-6 indicate that the water is moving toward the Detroit River. Rough estimations of water levels in the soil borings are consistent with this general direction of movement. Contours of the water table surface are presented in Figure 6.

The gradient of the water table is approximately 1.3%. This is consistent with the gradient of the clay surface. A cross section illustrating the ground surface, "natural" clay surface, and water level surface (Figure 5) demonstrates that the clay surface is the basement of the saturated zone and acts as a relatively impermeable surface; guiding the water toward the Detroit River. The movement of the water follows the traces of the sands and other more permeable fill materials as it travels toward the Detroit River. Lateral movement of the groundwater parallel to the Detroit River is restricted by the short travel distance to its discharge into the Detroit River.

Wells W-2 and W-3 are screened half in - half out of the water table. Wells W-4 through W-6 are screened completely below the water table. The wetted tape method for determining the water levels in W-2 and W-3 indicated that an oil layer is floating on top of the water table. The organic contaminant concentrations determined in these two wells exceed those determined in Wells W-4 through W-6 by an order of magnitude or more for the PNA compounds. This indicates that these compounds are transported primarily in this oil layer.

Levels of volatile organic compounds are also elevated in Wells W-2 and W-3. This indicates that those compounds are also preferentially transported in the oil layer.



LIST OF LOCATIONS

SOIL BORINGS	LOCATION	DATE COMPLETED	AIR WELLS	LOCATION	DATE COMPLETED
S-1	2 + 95N 2 + 27E	7/25/84	A-1	1 + 10N 4 + 20E	7/19/84
S-2	1 + 50N 3 + 30E	7/18/84	A-2	1 + 48N 9 + 85E	7/24/84
S-3	1 + 40N 4 + 40E	7/18/84	WATER WELLS	LOCATION	DATE COMPLETED
S-4	3 + 78N 4 + 52E	7/19/84	W-1	Dry Well	---
S-5	4 + 00N 5 + 71E	7/19/84	W-2	3 + 30N 8 + 05E	7/24/84
S-6	3 + 60N 7 + 52E	7/20/84	W-3	6 + 15N 11 + 73E	7/23/84
S-7	5 + 40N 7 + 75E	7/20/84	W-4	3 + 30N 9 + 00E	12/3/84
S-8	3 + 62N 8 + 94E	7/23/84	W-5	2 + 00N 12 + 14E	12/3/84
S-9	3 + 85N 7 + 28E	7/24/84	W-6	6 + 15N 11 + 47E	12/3/84
S-10	5 + 15N 10 + 30E	7/23/84	SURFACE SAMPLES	LOCATION	DATE COMPLETED
S-11	5 + 05N 11 + 80E	7/24/84	SS-1	5 + 84N 10 + 83E	9/05/84
S-12	1 + 75N 9 + 75E	7/24/84	SS-2	3 + 00N 11 + 00E	9/05/84
S-13	1 + 48N 8 + 97E	7/24/84	SS-3	2 + 00N 6 + 15E	9/05/84
S-14	1 + 82N 7 + 28E	7/24/84	SS-4	0 + 30N 6 + 00E	9/05/84
S-15	4 + 00N 11 + 50E	9/13/84	SS-5	0 + 37S 2 + 00E	9/05/84
S-16	5 + 50N 8 + 50E	9/13/84			
S-17	1 + 00N 5 + 00E	9/13/84			
S-18	3 + 36N 1 + 30E	9/13/84			
AS-1	1 + 10N 4 + 20E	10/4/84			
AS-2	2 + 00N 4 + 28E	10/4/84			
AS-3	1 + 38N 6 + 92E	10/4/84			
AS-4	3 + 41N 6 + 92E	10/4/84			
AS-5	0 + 60N 6 + 04E	10/4/84			

LEGEND

- Surface Sample (SS Series)
- Air Sample (AS Series)
- ⊙ Air Well (A Series)
- △ Water Well (W Series)
- ⊙ Soil Boring (S Series)
- ▭ Former Coal Gas Manufacturing Plant Structure.
- ▭ Existing Structure.
- Fence
- Railroad
- × Light Pole
- Guard Rail
- Catch Basin
- Power Pole
- Guy Pole
- 95.00 — Groundwater Contour

GROUNDWATER CONTOURS

12/13/84

FIGURE 6

REVISIONS DR. BY S.A.M. DATE 8/84 CHD. BY DATE 8/84		DATE 8/84	
* REVISED IN ACCORDANCE WITH CONSTRUCTION RECORDS		BY DATE	

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 877 CASCADE RD. PARK, S.E. GRAND RAPIDS, MI 49506 (616) 941-0371

MICHIGAN CONSOLIDATED GAS COMPANY

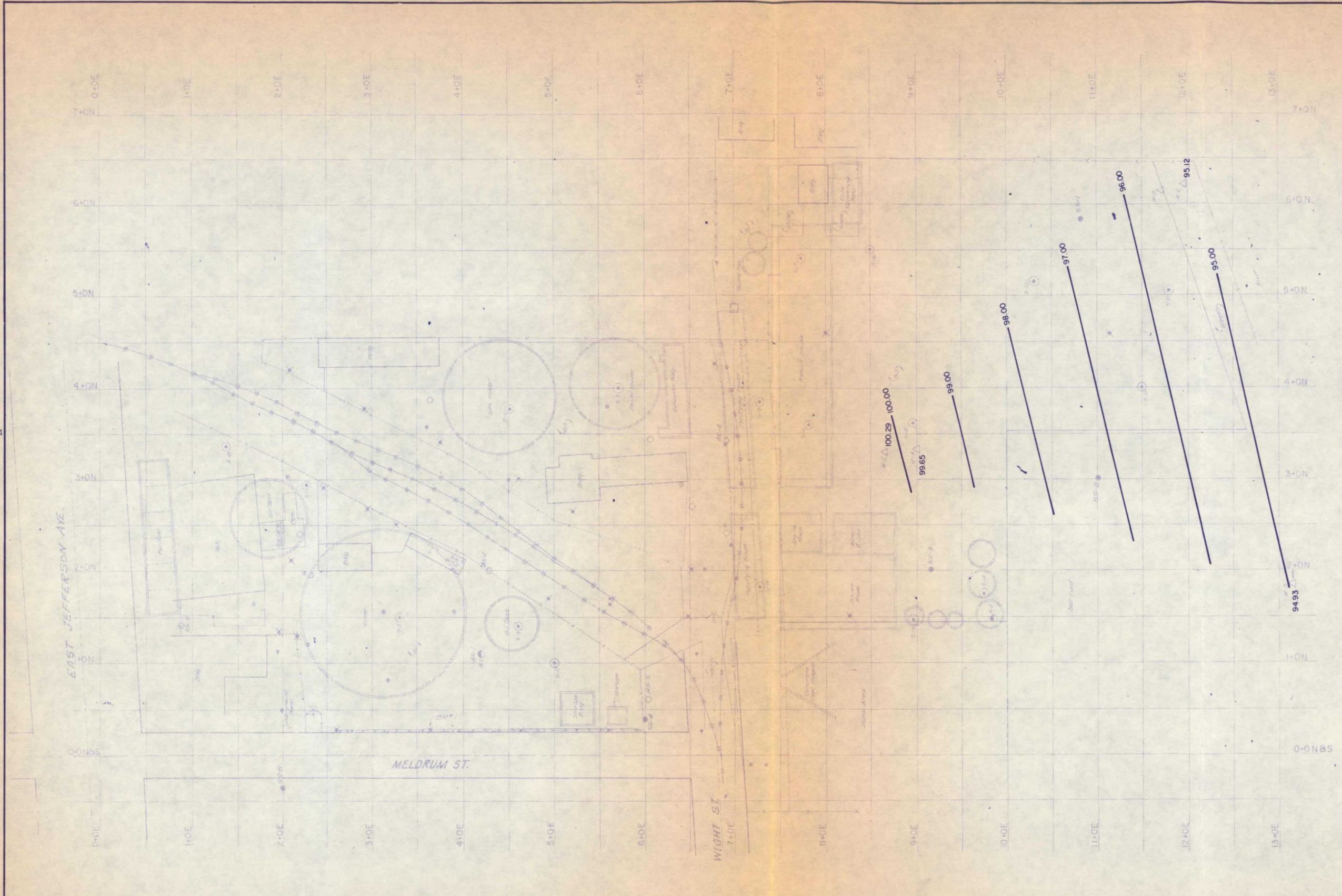
STATION B
 DETROIT, MICHIGAN

DATE
8/84

PROJECT NO.
20288

SHEET NO.
/

Note
B.M. #1 - B.S. Nail In N. Side Light Pole
3+63E, 0+27N Elev. 117.04



The oil layer is probably trapped behind the cement revetment along the river. The amount of contaminants thus entering the Detroit River directly from the site is better represented by the contaminant levels in Wells W-4 through W-6.

An estimate of the rate of groundwater discharge to the Detroit River from the site may be made using the gradient, an estimate of the cross sectional area of flow, and an estimated range of average permeability for the sediments. The length of river frontage for the flow emanating from the site is estimated to be approximately 600 feet. From the cross sectional view of the clay surface and water table surface (Figure 5), the saturated thickness is estimated to be approximately 9.0 feet. This yields a cross sectional area of flow of approximately 5,400 square feet. The average permeability of the sediments is estimated to range from 40 to 80 gallons per day per square foot (gpd/ft²). With the gradient of 1.3%, the estimated discharge rate ranges from 2,800 gallons per day to 5,600 gallons per day.

EFFECTS UPON THE DETROIT RIVER

The data collected in the groundwater survey of the site indicates that the groundwater flows in the direction of the Detroit River. This raises the possibility that the inorganic and organic contaminants detected in the groundwater under and downgradient to the site may be reaching the Detroit River. It is hypothesized that, should these contaminants be reaching the river, the dilution factor would be sufficient to reduce the concentrations at the outer edge of the mixing zone to below detection limits in the river after mixing. To confirm this hypothesis, a first level modeling approach has been applied to estimate whether the identified worst case groundwater contaminants are detectable or not at the edge of a hypothetical mixing zone in the Detroit River. A second evaluation technique examines the relative loadings of these contaminants upon the Detroit River in relation to other common loading sources within the Detroit area.

Surface Water Discharge Model Evaluation

For the worst case evaluation, we have used the simplest of possible models which involves the use of dilution calculations that neglect all reactions and/or transformations. In this approach, the inflowing contaminant is assumed

to mix uniformly with the ambient water. In the case of the Detroit River, we have chosen to apply a simple dilution formula to calculate the concentration of a contaminant at the edge of a hypothetical mixing zone after thorough mixing. The formula is:

$$C_m = \frac{G_e}{1/4 Q_r}$$

- Where:
- C_m - is the concentration of the contaminant at the outer edge of the mixing zone
 - G_e - is the estimated groundwater effluent concentration of the contaminant, mg/l. This value is obtained by multiplying the estimated groundwater discharge from the site to the Detroit River (l/d) by the estimated concentration of the contaminant in the groundwater (mg/l)
 - Q_r - Detroit River 7-day average historical low flow period, l/d

Data and assumptions required to perform the necessary calculations include:

- o Model and formula selection;
- o Contaminants of concern and concentrations;
- o Effluent flow quantities; and
- o Detroit River flow data.

Model and Formula Selection

The formula applied in the worst case concentration evaluation is a simple dilution formula used to estimate contaminant concentrations at the outer edge of a hypothetical mixing zone after release from a point source surface water discharge. Because no easily applied formula exists for calculating contaminant concentration values in a surface water mixing zone from an underground non-point source, we have selected this simple dilution formula because it fits fairly well when applying the following assumptions:

- It is understood from the beginning that the results of this model application will yield values that reflect estimated concentrations of a contaminant at the outer edge of a hypothetical mixing zone and does not reflect actual allowable discharge values.

- The groundwater flowing into the Detroit River has been treated as a point source. This assumption is conservative and results in concentration values that are probably higher than the actual situation. We assume for this calculation that all groundwater that flows to the river is hypothetically intercepted and eventually released in only one location; i.e., a point source.
- This simple dilution formula does not attempt to define the actual dimensions of the hypothetical mixing zone.
- The estimated contaminant concentration at the outer edge of the mixing zone will be evaluated against analytical detection limits. Only those contaminants that are estimated to be above the analytical detections will require further evaluation.
- The use of this formula is a good first level modeling tool to evaluate potential water quality problems as a result of the groundwater discharge into the Detroit River. Should the results of the evaluation indicate the need for a second level modeling application or additional evaluations, such activities could be undertaken in the future.

Contaminants of Concern and Concentrations

The five groundwater wells sampled from on-site and downgradient from the site locations detected various levels of inorganic and organic contaminants. In order to develop a worst case profile, the highest value from any of the five sample wells (W-2, W-3, W-4, W-5 and W-6) was selected to represent the worst case value for the various contaminants for use in the calculations. Many of these contaminants were found as floatable fractions in the samples and their values are above their solubility limits. These worst case, floatable fraction values are most likely not representative of the actual condition of all of the groundwater in the saturated zone under and downgradient from the site. This worst case profile for the inorganics and organic contaminants of concern and their concentrations are as follows:

Organics and Inorganics ⁽¹⁾			Organics ⁽¹⁾		
Chromium	0.25	mg/l	Xylene	3.9	mg/l
Mercury	0.0042	mg/l	Phenol	0.92	mg/l
Zinc	39.0	mg/l	Naphthalene ⁽²⁾	810	mg/l
Cyanide (total)	8.3	mg/l	Benzo(a)pyrene ⁽²⁾	820	mg/l
Cyanide (amenable)	4.7	mg/l	Benzo(a)fluoranthene ⁽²⁾	500	mg/l
Benzene	23.0	mg/l	Phenanthrene ⁽²⁾	280	mg/l
Toluene	2.8	mg/l	Fluoranthene ⁽²⁾	200	mg/l
Ethyl Benzene	6.7	mg/l	Pyrene ⁽²⁾	170	mg/l
			Acenaphthene	91	mg/l

(1) Lists selected high value representative inorganic and organics such as volatiles and polynuclear aromatic hydrocarbons found in W-2, W-3, W-4, W-5 and W-6.

(2) These values are in excess of actual solubility limits.

Effluent Flow Quantities

The following assumptions and calculations have been used to determine the possible volume of groundwater discharging into the Detroit River based upon on-site and off-site field collected water well data:

- Estimated discharge based on Darcy's Law, $Q = KIA$.
 - where: Q = Calculated discharge
 - K = Estimated hydraulic conductivity through medium sand
 - I = Groundwater gradient
 - A = Cross sectional area of groundwater saturated zone
- Length of exposure of the saturated zone along the Detroit River is estimated to be approximately 540 feet. The estimated average saturated thickness along this saturated zone is 8 feet. The estimated area of saturation connection with the Detroit River is approximately 4,320 square feet. This represents the value A in $Q = KIA$.
- Groundwater gradient $I = 0.023$.
- Assume a uniform subsurface material which generally has the characteristics of medium sand:
 - $K = 50$ gpd/sq ft (based upon an average permeability range)

- Estimated discharge

$$Q = KIA$$

$$Q = (50 \text{ gpd/sq ft}) (0.023) (4,320 \text{ sq ft})$$

$$Q = 4,968 \text{ gpd}$$

- In the calculation of G_e for the worst case scenario, we have taken a conservative estimate of 5,000 gpd or 1.8927×10^4 l/d as the groundwater flow into the Detroit River.

Detroit River Flow Data

For use in these calculations, we have selected worst case flow conditions in the river. In this respect, historical data from the U.S. Corps of Engineers in Detroit and the U.S. Geological Survey in Lansing shows that the lowest 30-day average flow for the Detroit River from the Fort Wayne gage was 100,000 cfs in February, 1939. However, the actual low flow in the channel of the Detroit River, which flows west of Belle Isle, is only 32% of the total recorded volume - in this case, 32% of 100,000 cfs. This equals 32,000 cfs. The MDNR formula uses 1/4 of the low flow data or 8,000 cfs. The flow of 8,000 cfs is equal to 5.1702×10^9 gpd or 1.9571×10^{10} l/d. This flow is used as the $(1/4 Q_r)$ value for the C_m calculations.

Results of Calculations

Worst Case Concentrations:

Using the data presented in the above sections and applying them to the dilution formula, C_m values can be determined for the worst case inorganic and organic contaminants of concern. Table 4 illustrates the results of these calculations. The C_m values are expressed in mg/l. Table 4 presents the estimated worst case groundwater contaminant values which have the potential to be released into the Detroit River from the site. These values are also expressed in mg/l.

As can be seen from the data, in all cases, the estimated concentration of each of the contaminants of concern at the outer edge of the mixing zone (C_m) are well below EDI analytical detection limits. That is to say, based upon dilution calculations, the concentrations of the substances theorized as being released to the Detroit River would not be detected in the river after thorough mixing.

TABLE 4
ESTIMATED CONCENTRATIONS OF CONTAMINANTS OF CONCERN
AT THE OUTER EDGE OF THE MIXING ZONE (C_m)
Estimated Worst Case Groundwater Discharge Values
in Relation to Detroit River Low Flow at 25% Mixing Level (mg/l)

<u>Inorganics</u>	Estimated ⁽¹⁾ Worst Case Water Value	C_m Value ⁽²⁾	Analytical ⁽³⁾ Detection Limits
Chromium (total)	0.25	2.4177×10^{-7}	0.09
Mercury	0.0042	4.0618×10^{-9} (MDNR Zero Discharge Policy)	0.0002
Zinc	39.0	3.7717×10^{-5}	0.02
Cyanide (total)	8.3	8.0269×10^{-6}	0.01
Cyanide (amenable)	4.7	4.5453×10^{-6}	0.01
<u>Organics</u>			
Benzene	23.0	2.2243×10^{-5}	0.001
Toluene	2.8	2.7079×10^{-6}	0.001
Ethyl Benzene	6.7	6.4795×10^{-6}	0.001
Xylene	3.9	3.7717×10^{-6}	0.01
Phenol	0.92	8.8973×10^{-7}	0.01
Naphthalene	810	7.8335×10^{-4}	0.001
Benzo(a)pyrene	820	7.9302×10^{-4}	0.01
Benzo(k)fluoranthene	500	4.8355×10^{-4}	0.01
Phenanthrene	280	2.7079×10^{-4}	0.001
Fluoranthene	200	1.9342×10^{-4}	0.001
Pyrene	170	1.6441×10^{-4}	0.001
Acenaphthene	91	8.8006×10^{-5}	0.001

(1) Estimated groundwater values have been derived from worst case field data collected from groundwater wells W-2, W-3, W-4, W-5, and W-6.

(2) Calculated from Simple Dilution Formula:

$$C_m = \frac{G_e}{1/4 Q_r}$$

C_m values do not represent actual allowable point source discharge concentrations for the Detroit River. Actual discharge values are established and controlled by pretreatment effluent discharge values.

(3) Represents the analytical detection limits used by EDI in this investigation.

The above evaluation has reviewed the estimated worst case groundwater effluent discharge from the site into the Detroit River and how the contaminants would dilute in a hypothetical mixing zone. This evaluation was based on taking the worst case values for each contaminant as found in any of the sample wells. For conservative estimate purposes, we used these values to represent the levels of contaminants entering the Detroit River in the groundwater effluent. However, these worst case contaminant concentrations are probably not representative of the actual condition of all of the groundwater under and downgradient from the site, nor is it considered representative of the groundwater concentrations that are potentially reaching the Detroit River.

In actuality, the concentrations reaching the river are probably less than the worst case values and more closely associated with average concentrations for the contaminants found in each of the outer observation wells (W-4, W-5 and W-6). Wells W-4, W-5 and W-6 were placed to obtain water samples from the middle of the saturated zone and not the groundwater-subsoil interface as was the case for W-2 and W-3. In calculating the average values for the various contaminants, detection limit values were used in the summation step when the contaminant was not actually present in a specific well sample. The average concentrations for wells W-4, W-5 and W-6 are as follows:

	<u>Average Concentrations</u>	
Chromium (hexavalent)	0.09	mg/l
Mercury	0.00037	mg/l
Zinc	15.37	mg/l
Cyanide (total)	1.83	mg/l
Cyanide (amenable)	1.62	mg/l
Benzene	0.087	mg/l
Toluene	0.012	mg/l
Ethyl Benzene	0.164	mg/l
Xylene	0.103	mg/l
Phenol	0.063	mg/l
Naphthalene	1.005	mg/l
Benzo(a)pyrene	0.01	mg/l
Benzo(k)fluoranthene	0.01	mg/l
Phenanthrene	0.257	mg/l
Fluoranthene	0.067	mg/l
Pyrene	0.094	mg/l
Acenaphthene	0.059	mg/l

In the case of mercury, dilution calculations were performed for comparative purposes only because the MDNR has an established policy of requiring zero

discharge of mercury to Michigan surface waters. With this restriction in mind, the detected value of 0.0042 mg/l (worst case) or 0.00037 mg/l (average) in the groundwater would constitute an unacceptable discharge limit. However, to put these values in perspective, it can be pointed out that the average concentration of total mercury in the Combined Sewer Overflows (CSO) to the Detroit River is approximately 0.045 mg/l, based upon a 1982 EPA study on combined sewer overflows for the Detroit River. In relationship to mercury loading to the river, the estimated mercury discharge to the river from the contaminated groundwater discharge would be approximately 0.06397 pounds (0.00303 kg) of mercury a year for the worst case scenario or 0.00564 pounds (0.00267 kg) of mercury per year for the average case scenario. The estimated yearly loading from the CSO's would be approximately 3,180 lbs (1,450 kg), which is based upon the flow from the three most significant CSO discharges. Methyl mercury is a toxic substance that can be acutely toxic to some aquatic organisms in excess of 1 mg/l. Below this level, methyl mercury becomes a bioaccumulation concern. Bioaccumulation is the primary cause for the MDNR concern for discharges of mercury in the range found in the groundwater under the site. It has not been determined whether or not the mercury found in the groundwater effluent is methyl mercury. Regardless of the form the mercury is in, a discharge of 0.06397 pounds per year or less would not appear to be a significant contribution to the Detroit River.

In keeping with the above analysis, it may be of interest to look at the estimated annual loadings to the Detroit River for the other contaminants of concern. Using the average case values and a groundwater discharge rate of 5,000 gallons per day (gpd), the calculated annual discharge loadings to the Detroit River for the contaminants of concern would be:

Chromium	1.3707 lbs	(0.64864 kg)
Zinc	234.0900 lbs	(110.7700 kg)
Cyanide (total)	27.8700 lbs	(13.1890 kg)
Cyanide (amenable)	24.6700 lbs	(11.6750 kg)
Benzene	1.3251 lbs	(0.62702 kg)
Toluene	0.1828 lbs	(0.00865 kg)
Ethyl Benzene	2.4978 lbs	(1.1820 kg)
Xylene	1.5687 lbs	(0.74233 kg)
Phenol	0.9595 lbs	(0.45405 kg)
Naphthalene	15.3070 lbs	(7.2431 kg)
Benzo(a)pyrene	0.1523 lbs	(0.07207 kg)
Benzo(k)fluoranthene	0.1523 lbs	(0.07207 kg)
Fluoranthene	1.0204 lbs	(0.48287 kg)
Pyrene	1.4317 lbs	(0.67746 kg)
Acenaphthene	0.8986 lbs	(0.42522 kg)

As can be seen from these numbers, the total discharge loading of contaminants into the Detroit River on an annual basis is low. It must be emphasized that these values were derived using average case contaminant concentrations and assuming that the entire daily volume of groundwater is completely contaminated by the average case concentrations. This, undoubtedly, is a very conservative approach and one which is probably not, in fact, occurring. The discharge of these quantities into the Detroit River on an annual basis would not appear to pose a significant concern to the aquatic ecosystem of this stretch of the Detroit River.

SUMMARY

DISCUSSION

Soil borings and analytical testing indicate the presence of subsurface chemicals associated with the former coal gas manufacturing plant in the soil and in the groundwater beneath the site. The presence of contaminants themselves at the site, however, does not immediately lead to the conclusion that there is a significant adverse environmental impact. If the contaminants were not contained and able to move from the site and cause adverse effects on the human population and the environment, only then would that conclusion be valid.

Soils with significant chemical concentrations are located below the ground surface, typically between 2.5 to 13.0 feet below grade. As discussed by the toxicologist, human health hazard does not exist when there is no exposure to the chemicals of concern. Existing on-site subsurface contaminated soils are contained below the surface and not available for human contact through activities connected with normal site usage.

Chemical analyses of surface soil samples indicate contaminants associated with the coal gas manufacturing plant are within a 5 to 10-fold range concentrations found off-site in typical urban Detroit soils.

Groundwater beneath the site, while containing concentrations of parameters above established safe drinking water standards and USEPA and U.S. Public Health Service recommended guidelines for drinking water quality parameters, is not used as a drinking water source and, therefore, isolated from human consumption. The low amounts of contaminants found in the groundwater confirms that some leaching of the contaminants in the soil is taking place. This situation would explain why the groundwater contaminant levels are low as compared to levels in the subsurface soils.

The low concentration of the contaminants in the groundwater entering the Detroit River would not be found at the outer edge of the hypothetical mixing zone in excess of the analytical detection limits used in this investigation. This conclusion is based upon the use of a simple surface water discharge

dilution formula. The results of the calculations from the formula suggest that the contaminants of concern at the outer edge of the hypothetical mixing zone would be very low and well below analytical detection limits.

Monitoring wells installed for this project reveal that the groundwater flows toward the Detroit River. Lateral movement of this water is not a concern due to the proximity of the site to the discharge zone - the Detroit River. The vertical permeability of the underlying clay soils acts as a barrier to vertical migration of contaminants.

Any site development that necessitates subsoil excavation or surface soil restoration/revegetation activities will require special handling and analysis of soils and groundwater. In this regard, we have included some general guidance on this issue.

SPECIAL SITE DEVELOPMENT CONSIDERATIONS

General Soil Conditions

The borings at Station B, the southern portion, encountered 3.5 to 13 feet of fill materials above a sloping, natural, clay surface. Fill materials were comprised of primarily fine to medium sands but also included clays, gravels, concrete, cinders, bricks, wood, black oily material, and rubble. The clay surface below the fill slopes at a 1 to 3 percent grade towards the Detroit River. Groundwater which occur approximately 4 to 6 feet below existing grade is likely influenced by the sloping impermeable, clay layer below.

Construction and Excavation

Foundations for any proposed structures will likely extend to the underlying clay subsoils to develop support. This could be accomplished through excavation of subsurface fill soils or through the installation of piling or piers to transfer building loads to the underlying firm clay strata.

It is not expected that all excavated material will have to be disposed of as hazardous waste; however, chemical analysis of soils in areas requiring excavation is recommended to determine appropriate disposal methods or to segregate

hazardous from nonhazardous soils. See Appendix C for a discussion of the Resource Conservation and Recovery Act (RCRA) regulatory interpretation of coal gasification plant wastes.

Groundwater control will likely be necessary if excavation to the clay surface is required due to the shallow water levels found on the site. Additional groundwater testing before dewatering is appropriate to determine parameters for disposal of water.

Special materials may be required in the construction of foundations. Depending upon the chemical analysis of the excavated soil, sulfate resistant concretes may be required for foundation construction. The use of such special materials may be needed to protect the concrete foundation from chemical degradation.

Construction, excavation and material handling should follow proper health and safety precautions as determined by chemical analysis.

Phytotoxicity

Analyses of surface soils taken from the southern portion of Station B do not indicate levels of contaminants that would necessarily preclude plant growth. However, investigation by a British research team (Wilson & Stevens) revealed that chemicals from coal gasification sites may complex with nutrients in the soils, thus reducing the amount available for uptake by plants and eventually cause phytotoxicity. Likewise, the presence of certain metals may be in sufficient concentrations or in readily available forms so as to cause toxic effects upon certain lawn grasses and ornamental shrubs or trees.

A soil audit (nutrient availability and metal speciation) of surface soils to determine compatibility with proposed landscaping at the time of development would be appropriate.

APPENDIX A

EVALUATION OF DR. JAY GOODMAN, CERTIFIED TOXICOLOGIST

Jay I. Goodman, Ph.D.

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and Toxicology
Michigan State University
East Lansing, MI 48824
Phone (517) 353-9346

October 25, 1984

Robert Masselink, P.E.
EDI Engineering & Science
611 Cascade West Parkway, S.E.
Grand Rapids, MI 49506

Dear Mr. Masselink:

This letter summarizes my evaluation of the data which I received from your office on October 22 and 23, 1984 regarding analysis of air, surface samples, subsurface soil and ground water samples taken from the former coal gas manufacturing plant, Station B, Detroit, Michigan.

Air Samples The air samples were analyzed for three volatile aromatic compounds (benzene, toluene and xylene). These are possible contaminants of the air as a result of their evaporation from the deposits located several feet beneath the surface. From the toxicological point of view, benzene is the most significant member of the group of compounds assessed. This is because of the solid data indicating that benzene is capable of causing cancer in man.

The detection limits employed (80 ug/m³ for benzene and xylene, and 100 ug/m³ for toluene) for the analysis are reasonable. For example, one would expect to find benzene in urban air at a level of approximately 50 ug/m³. It is quite difficult to measure it at this concentration and employing a detection limit of 80 ug/m³ places one within the proper range. At this detection limit one can see whether or not there is benzene present at levels which are significantly out of line with what would be expected. To place this into proper perspective I should indicate that: 1) The benzene level in the air in the vicinity of a gasoline service station is approximately in the range of 400 ug/m³ to 10,000 ug/m³. 2) The benzene level in cigarette smoke is approximately in the range of 150,000 ug/m³ to 200,000 ug/m³.

Subsurface air well A-1 revealed the presence of benzene (450 ug/m³), toluene (320 ug/m³) and xylene (770 ug/m³). This finding is not surprising in view of the chemicals contained in the subsurface soil samples (discussed below). A total of five ambient air samples were analyzed. None of these contained any detectable levels of benzene, toluene or

xylene. This indicates that the volatile chemicals which are present below the surface are contained there.

The data regarding the air samples indicates that the ambient air in the vicinity of Station B poses no significant hazard to human health.

Surface Samples Three surface soil samples (SS-1, SS-2 and SS-3) plus two samples from the surface of asphalt pavement (SS-4 and SS-5) were analyzed for a wide variety of organic chemicals (including polycyclic aromatic hydrocarbons and cyanide) plus heavy metals. The list of chemicals which the samples were assayed for includes the variety of chemicals which were detected several feet beneath the surface (this is discussed below).

The detection limits employed for the analysis appear to be reasonable. One expects to find, for example, heavy metals and polycyclic aromatic hydrocarbons in surface soil in concentrations approximately in the mg/kg (parts per million, ppm) range.

In view of the fact that your letter of 10/19/84 indicates that there is some question regarding the validity of the values reported for selenium I shall hold my comments regarding this metal in abeyance pending receipt of your reevaluation of this matter.

The results of the analysis indicate that: 1) Volatile compounds were not detected in any of the surface samples analyzed. This is an indication that the volatile compounds which were detected several feet below the surface are contained there. This conclusion is supported by the data on the ambient air samples, discussed above. 2) A variety of heavy metals and organic compounds (including polycyclic aromatic hydrocarbons and cyanide) were detected. However, these are either in the same concentration range (i.e., within approximately a five- to ten-fold range) as that which was found in surface samples taken from other locations in the Detroit area or, in the case of SS-4 and SS-5, not out of line with what one might have anticipated in view of the fact that these are scrapings from asphalt.

There appears to be an error in the Executive Summary, 4th paragraph on page i of the preliminary Site Investigation Report for Station B. It states that a surface sample contained cyanide (the analytical method employed measures total cyanide) at a concentration of 50 mg/kg (50 ppm). This statement is repeated in the second paragraph on page 16 of

the preliminary report. However, the data which I have received indicates that cyanide was NOT detected in any of the surface soil samples. The surface asphalt samples, SS-4 and SS-5, did contain cyanide at 3.2 ppm and 0.29 ppm, respectively. This is within the general range (i.e., within approximately a five- to ten-fold range) of the values reported for surface samples taken from other locations in the Detroit area. These surface cyanide levels do not appear to present a significant hazard. In addition, the second sentence of the portion of the Executive Summary, referenced above, presents a less than accurate picture of my comments regarding cyanide which were presented in my letter of 10/11/84. This should be either deleted or modified.

The data regarding the surface samples indicate that the chemicals at the surface of Station B present no significant hazard to human health.

Subsurface Soil Samples Subsurface soil samples were analyzed for a wide range of potentially toxic organic compounds (including benzene, cyanide and polycyclic aromatic hydrocarbons) and heavy metals.

The range of chemicals for which analysis was performed and the detection limits employed appear to be reasonable. It is noteworthy that the borings were prescreened to select those samples which contained significant levels of volatile compounds such as benzene and/or polycyclic aromatic hydrocarbons. The prescreening procedures do not appear to be capable of detecting heavy metals or cyanide. In view of the complete analysis performed on the soil borings selected plus the surface and water samples, which are not prescreened, it appears reasonable to do this type of prescreening. This provides a conservative approach which is both time and cost effective while yielding data from the "worst" samples of soil borings, which are as likely as any to contain cyanide and/or heavy metals.

The results of the analysis indicate that a wide variety of potentially toxic chemicals were detected at concentrations which could pose a hazard to human health if people were in contact with the soil.

In view of the fact that the chemicals in question are present below ground at potentially toxic levels, and appear to be contained there, they pose no significant hazard to people at the surface of Station B.

Robert Masselink

10/25/84

Page 4

Ground Water Samples Ground water samples were analyzed for a wide variety of potentially toxic organic compounds (including benzene, cyanide and polycyclic aromatic hydrocarbons) and heavy metals.

The range of chemicals for which analysis was performed, and the detection limits employed, appear to be reasonable.

The results of the analysis indicate that a wide variety of potentially toxic chemicals were detected at concentrations which could pose a hazard to human health if people were in contact with the water. This water is clearly not acceptable for drinking water.

Some of the compounds, i.e., the polycyclic aromatic hydrocarbons, are reported to be present at concentrations above their solubility in water. This is probably a result of them being dissolved in some oil which was mixed with the samples.

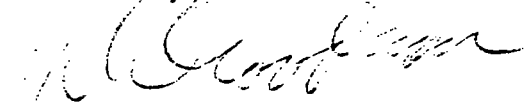
The ground water does not appear to be a source of drinking water and, to the extent that this is true, it poses no significant hazard to human health.

In summary, the data from the air and surface samples indicate that Station B, in its present condition, poses no significant hazard to human health. To the extent that the chemical contaminants below ground at Station B are contained there they pose no significant health hazard. In view of the fact that the ground water might flow to the Detroit River it would be reasonable to ascertain the extent to which this occurs and the impact, if any, that this might have on the river.

The question of whether or not selenium is present at concentrations which might cause problems is one which can be addressed after your reevaluation of its analysis.

Please do not hesitate to contact me if you have any questions or comments concerning this letter.

Sincerely,



Jay I. Goodman, Ph.D.
Professor

APPENDIX B

DRINKING WATER QUALITY STANDARDS
NATIONAL INTERIM PRIMARY REGULATIONS

AND

GUIDELINES FOR
DRINKING WATER QUALITY PARAMETERS

NATIONAL INTERIM PRIMARY REGULATIONS (SDWA)
FOR DRINKING WATER
(40 CFR, PART 141 as amended)

This establishes primary drinking water regulations for municipal drinking water supply pursuant to Section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act (Pub. L. 93-523).

<u>Contaminant</u>	<u>Maximum Contaminated Level</u>
Inorganic Chemicals (total constituent values)	
Arsenic	0.05 mg/l
Barium	1.0 mg/l
Cadmium	0.010 mg/l
Chromium	0.05 mg/l
Lead	0.05 mg/l
Mercury	0.002 mg/l
Nitrate (as N)	10.0 mg/l
Selenium	0.01 mg/l
Silver	0.05 mg/l
Fluoride	2.4 mg/l
Organic Chemicals	
Endrin	0.0002 mg/l
Lindane	0.004 mg/l
Methoxychlor	0.1 mg/l
Toxaphene	0.005 mg/l
2,4-D	0.1 mg/l
2,4,5-TP Silvex	0.01 mg/l
Total Trihalomethanes	0.10 mg/l
Turbidity	1 TU-5 TU
Coliform Bacteria	<1/100 ml (mean)
Radiological	
Radium -226 and -228	5 pCi/l
Gross Beta	4 mrem/year (50 pCi/l)
Gross Alpha	15 pCi/l

GUIDELINES FOR DRINKING WATER QUALITY PARAMETERS

Parameters	Concentration Level	Application	Source
Alkyl Benzene Sulfonate (ABS)	0.5 mg/l	Mandatory	USPHS
Alkalinity	(not a specific polluting substance)		
Ammonia (NH ₄)	0.10 mg/l	Recommended	USPHS
Arsenic	0.01 mg/l	Recommended	USPHS
Arsenic	0.05 mg/l	Mandatory	USEPA
Barium	1.0 mg/l	Mandatory	USPHS, USEPA
Cadmium	0.01 mg/l	Mandatory	USPHS, USEPA
Calcium	75 mg/l	Recommended	WHO
Carbon Chloroform Extract	0.2 mg/l	Recommended	USPHS
Chlorine	250 mg/l	Recommended	USPHS
Chlorine	Very high levels will be objectionable		
Chromium (Total)	0.05 mg/l	Mandatory	USPHS, USEPA
COD	50 ppm	Recommended	USEPA
Color	15 units	Recommended	USPHS
Conductivity	Function of dissolved solids		
Copper	1.0 mg/l	Recommended	USPHS, USEPA
Corrosivity	Non-corrosive		
Cyanide	0.01 mg/l	Recommended	USPHS
Cyanide	0.2 mg/l	Mandatory	USEPA
Dissolved Solids	500 mg/l	Recommended	USPHS
Dissolved Oxygen	No limits	N/A	
Foaming Agents	0.5 mg/l	Recommended	USEPA
Hardness as CaCO ₃	300 ppm	Recommended	USPHS, USEPA
Herbicides	Not established	N/A	
Hydrocarbons	0.2 ppm	Recommended	
Hydrogen Sulfide	0.05 mg/l	Recommended	USEPA
Iron	0.3 mg/l	Recommended	USPHS, USEPA
Lead	0.05 mg/l	Mandatory	USPHS, USEPA

This information provides guidance or working values for various substances as they relate to assessing effects upon drinking water quality. As indicated, some of the values are established as mandatory requirements, others are purely recommendations or guidelines.

Reference Sources: USPHS - United States Public Health Service
USEPA - United States Environmental Protection Agency
WHO - World Health Organization
MDNR - Michigan Department of Natural Resources

GUIDELINES FOR
DRINKING WATER QUALITY PARAMETERS
(Continued)

Parameters	Concentration Level	Application	Source
Magnesium	No limits	N/A	USPHS
Magnesium and Sodium Sulfate	500 mg/l	Permissible	WHO
Magnesium and Sodium Sulfate	1,000 mg/l	Excessive	WHO
Manganese	0.05 mg/l	Recommended	USPHS, USEPA
Mercury	0.002 mg/l	Mandatory	USEPA
Molybdenum	0.01 mg/l	Recommended	USPHS
Nickel	0.1 mg/l	Recommended	USEPA
Nitrate (as N)	10.0 mg/l	Mandatory	USEPA
Nitrate (as NO ₃)	45 mg/l	Recommended	USPHS
Nitrogen Ammonia (as NH ₄ ⁺)	0.5 mg/l	Recommended	USPHS
Nitrogen Nitrite	2 mg/l	Recommended	MDNR
Nitrogen Organic	No limits	N/A	
Odor	#3	Mandatory	USPHS
PCB	No limits	N/A	
Pesticides	Not established	N/A	
Phenolic Compounds (as Phenols)	0.001 mg/l	Recommended for Domestic Use	USPHS
pH	6.5-8.5	Recommended	USEPA
Phosphate	0.001 mg/l	Mandatory	USPHS, USEPA
Potassium	1,000-2,000 mg/l	Recommended Extreme limit	MDNR
Selenium	0.01 mg/l	Mandatory	USPHS, USEPA
Silica	No limits	N/A	MDNR
Silver	0.05 mg/l	Mandatory	USPHS, USEPA
Sodium	20 mg/l	Recommended	N/A
Sulfate	250 mg/l	Recommended	USPHS, USEPA
Sulfide	0.002 mg/l	Recommended	USPHS
Tannates (see color, page B-2)			
Total Dissolved Solids	500 mg/l	Recommended	USPHS, USEPA
TOC	<10 mg/l	Recommended (Compare to background)	MDNR
Turbidity	5 units	Mandatory	USPHS
Zinc	5 mg/l	Recommended	USPHS, USEPA

APPENDIX C

MEMO DATED JANUARY 10, 1985, FROM K. LYNNE TO FILE (20356)
RE: RCRA REGULATORY INTERPRETATION OF
COAL GASIFICATION PLANT WASTES

PROJECT MEMORANDUM

TO: Files
FROM: K. Lynnes
RE: RCRA Regulatory Interpretation of
Coal Gasification Plant Wastes
DATE: January 10, 1985

I spoke with Timothy O'Mara of the Environmental Protection Agency's (EPA) Waste Management Division concerning the contaminated soils at Michigan Consolidated Gas Company's former coal gas manufacturing plant (Station B). According to Mr. O'Mara, soils contaminated by coal gasification wastes are not exempt from Resource Conservation and Recovery Act (RCRA) under 40 CFR 261.4 (b)(7). If the soils exhibit one or more of the characteristics identified in Subpart C of 40 CFR 261, MichCon would be considered a generator of hazardous waste should they choose to excavate these soils.

The exemption for solid wastes from the extraction, beneficiation, and processing of minerals (including coal) is interpreted broadly by the EPA, but it only extends to those wastes that are "unique" to the mineral processing operation. In the January 21, 1981 Office of Solid Waste Memorandum on "RCRA Mining Exemption and Synfuel Plants", Mr. Thoem stated that the exemption "clearly" extended to the direct gasification of coal and the wastes produced by those operations (e.g., coal tar, wood chips, coke, ash, etc.). Although applicable state and federal rules for non-hazardous solid waste management would be pertinent in these cases, it is likely that non-hazardous solid waste landfills would not accept these wastes and that they would have to be disposed of in a hazardous waste landfill.

Even though the contaminants in the soil at Station B can probably be traced to the coal gasification plant, the contaminated soil is not a waste that is unique to the gasification process and is therefore not included in the RCRA mining exemption.

The mining exemption found in the Michigan Hazardous Waste Management Act (R299.6202(a)(q)) is essentially identical to the federal statute (42 USC 6921(b)(3)(A)(ii)). While coal is not specifically included in this exemption, Ms. Joan Peck of the Michigan Department of Natural Resources (MDNR) Hazardous Waste Division stated that coal is considered a mineral for the purposes of this exemption. Ms. Peck concurred with the EPA position that soils contaminated by coal gasification wastes are not covered by the mining exemption.

RCRA Mining Exemption and Synfuel Plants [40 CFR 261.4(b)(7)]

RCRA regulates the generation, storage, treatment, transportation, and disposal of hazardous wastes. 40 CFR 261.4(b)(7) specifically exempts solid waste from the "extraction, beneficiation, and processing of ores and minerals (including coal)" from hazardous waste regulations. These wastes are subject to the less stringent RCRA rules for solid waste disposal. Wastes produced from coal gasification fall under this exemption if they are "unique" to the coal processing operation.

Soils contaminated by coal gasification processing wastes are not considered unique to the processing operation and are not covered by the RCRA mining exemption. If these contaminated soils are excavated, their treatment, transport, and disposal may be covered by RCRA hazardous waste regulations. The key determination in this situation is whether the soils are classified as hazardous under the definitions found in 40 CFR 261, Subpart C. Should the soils exhibit one or more of the characteristics identified in Subpart C (ignitability, corrosivity, reactivity, or toxicity), they would be subject to hazardous waste regulations under RCRA.